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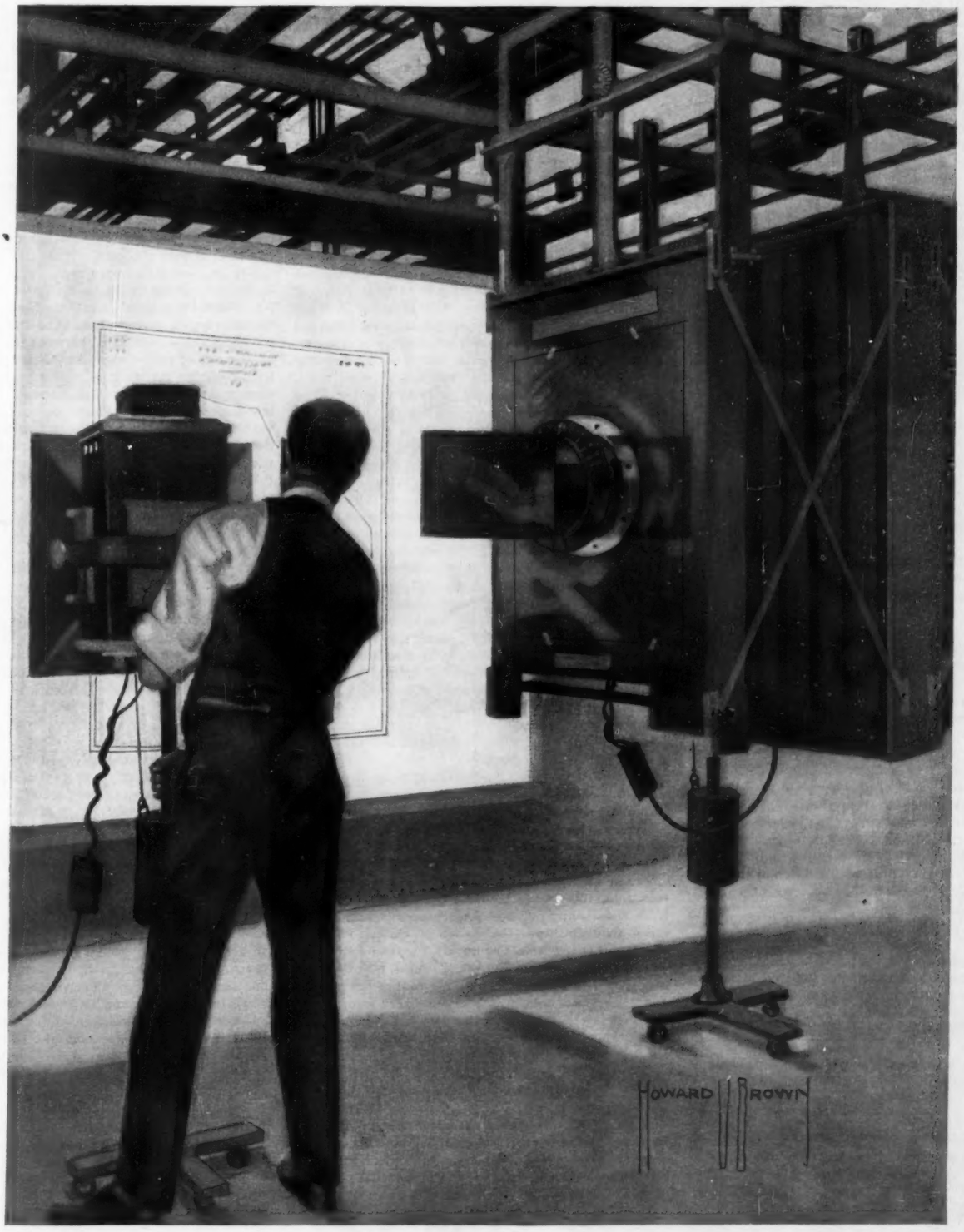
HIGH PRESSURE STEAM

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



OPERATING A HUGE CAMERA IN THE REPRODUCTION OF MAPS.—[See page 253]

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Disarmament and Pacifism

THERE is a minority—a very small minority—among us which looks with disfavor upon the disarmament conference which has been called by President Harding. The attitude of these gentlemen ranges from a mirthful skepticism to bitter opposition, an opposition which is none the less fierce because it is of necessity suppressed or mentioned in most guarded terms. The principal charge brought against the whole idea of disarmament is that it has been brought about by the persistent effort of the pacifist.

Now, we have given much thought and investigation to this matter, and we are convinced that while the out-and-out pacifist is naturally in favor of the conference, these extremists represent only a very small minority among that all-but-unanimous majority which has welcomed President Harding's action in the belief that it will result in untold benefit to humanity.

The out-and-out pacifist is a man whose mental processes are badly twisted. Not only is his logic out of balance, but his vision is so limited that his mind is never presented with more than a fraction of the facts upon which to base his conclusions. Instead of looking out upon the world with the full angle of vision intended by his Creator, in which he can see things in their relative proportions, he looks through a telescope, sees one object at a time and forgets that he is not looking at the whole world, but only a very small portion of it.

Peace? Certainly we all of us are in favor of peace; but we want a peace based upon law and founded upon a just regard not only for the rights of other people, but for our own rights. The complete abolition of armaments demanded by the pacifist would be the greatest possible inducement to disorder. The soldier and the sailor are merely the policemen of the nation. What would become of our rights and our property if we disbanded all the police forces of our great cities? If the fabled millennium should ever come, a police-less, army-less and navy-less world would be possible—but never till then. Now, as our readers well know, the SCIENTIFIC AMERICAN is in favor of a judiciously regulated disarmament. Not of the complete abolition of arms, but of a regulated disarmament, which shall cut out crazy competition and lead to the adjustment of a nation's naval and military strength in accordance with the existing and the probable future international conditions. That is a very different thing from pacifism. Pacifism is a peril to the future security of nations. Regulated armament by agreement among the nations will conduce to national safety, peace and well-being.

The spirit of the forthcoming conference will be determined very largely by the spirit in which we enter it, and the attitude which we assume toward the nations which we have invited to meet us around the table. Because of the unique position in which the world war has left us, our influence at the conference is bound to be predominant. It is *our* conference, called by our President, for the purpose of settling certain outstanding and very disturbing international questions, mainly in the Pacific. If we enter that conference with the conviction that the rest of the world is prepared to be just as honorable, just as fair, just as frank as ourselves, we shall give a tone to the whole series of discussions which will carry them through to a brilliant accomplishment. It should be for us to remember that the world which we have invited to meet us is a broken world, a world that is very sick and wounded almost to death. Our guests will enter the conference bearing a crushing load, imposed by their naval and military armament; and we firmly believe that there is not one of them but will come to the conference eager to have that burden lightened as much as may be humanly possible.

The spirit of the conference will depend very largely, also, upon the attitude of the naval and military officers who will advise the conferees and upon whether or not they give loyal support to the President, the Commander-in-Chief of both the Army and the Navy, in his noble effort to assist the nations to adjust their outstanding problems and throw off the crushing burden of overdeveloped armament. Such an attitude will go a long way toward securing the desired results. As regards the press, it is to be hoped that journalists and reporters, not merely of this country but of all the countries concerned, will realize the need for great caution in discussing the deliberations of the conference. A consistently friendly attitude and a determination to avoid the sensational and the disturbing, and to record the doings of the conference with the most literal fidelity to the facts, will go far toward making it a brilliant success and a notable landmark not merely in our national history, but in the whole progress of civilization.

The Technique of Road Repairing

THOSE of us who have traveled over the fine highways of Europe cannot have failed to notice, at intervals along the roadside, men who were engaged in breaking up stones to a size suitable for road repair. In addition to his pile of broken stones, each man would have another pile of sand or other road-mending material. His equipment would include a wheelbarrow, a shovel and a pick-axe. Occasionally the traveler will come across a man who is patrolling the road and looking for the first indication of wear. He is not long in finding what he is looking for. The incipient breakdown of the road may be very insignificant; possibly it will be merely a small pool of water left by a passing shower, which, to his experienced eye, is an indication that a slight deterioration of the roadway has set in at that point. With his pickaxe he carefully breaks up the surface and fills in the depression with some sand and broken stone or gravel, smoothing over the new surface and leaving the passing traffic to compact the newly laid material.

Although these operations are very simple, they exemplify that system of careful detailed supervision and constant repair to which the main roads of Europe owe their very fine condition. Long experience has taught these roadmakers that this careful supervision, this ceaseless vigilance, this early detection and instant repair of the very first evidences of disintegration, constitute the only practicable method of keeping a road in permanent, first-class condition.

Our highway commissions should consider the practice of the railroads, where a complete organization is maintained for the upkeep of the track, with section gangs, foremen, superintendents, engineers and so on, up to one man upon whose shoulders rests the ultimate authority and responsibility for the whole system. Only by such methods can our rapidly growing network of highways be economically and permanently maintained.

Here is a lesson which we may well lay to heart. Too often our methods of road maintenance are as different from those followed in the older countries as could well be. Consequently our newly built macadam and gravel roads soon fall into that state of chronic disrepair which still characterizes so large a part of our highway mileage. It will be understood, of course, that the above is not written with reference to the best of our concrete and Tarvia roadbeds, which have reached such a point of excellence that, except under very heavy motor truck traffic, they are not subject to a rapid breakdown. However, on our very finest roads of this class it would be advisable to maintain a system of rigid inspection, and see to it that any spot where weakness develops is at once restored.

Our plea is on behalf of the grade of roads which is intermediate between a concrete road and the simplest country road. Upon these the European system of ceaseless patrol and repair could be introduced, with a vast saving of public funds and with enormous advantage to the traveling public. Too often, after building a stretch of highway, the road is left to the mercy of the elements and the unending wear and tear of traffic. Instead of patrolling the new roadway with men who are equipped for the repair of any incipient breakdown, we allow the surface to be wrecked by constant traffic, and only when the road has been so badly wrecked as to be unusable do we begin to think about repairs. These are carried out in our usual wholesale fashion; the traffic for the time being is completely disorganized; and when the repair job has been done, the road is once more left to undergo the old routine of destruction.

The Source of Inspiration

THERE must be readers to whom the psychology of the editorial page has at one time or another presented an interesting problem. When the "ZR2" falls into the river and the calamity is followed by a denunciation or a defense of the dirigible as opposed to the airplane, or a critical analysis of the structural features of this particular craft, or a general discussion of the scientific spirit of investigation which gets the most out of such a disaster as opposed to the layman's inclination toward mere panic, it is obvious where to look for the source of the editor's inspiration. Current events and timely topics, which provide the entire supply of ideas for the editorial writer of the daily newspaper, play in the life of the magazine editor a part merely less inclusive. They must necessarily provide, to everyone who writes, a goodly part of the ideas that are necessary before one can go into executive session with pen or typewriter.

But the weekly and even more the monthly sheet has to exercise discretion in its choice of "current" topics for editorial discussion, for the majority of such topics do not remain current and alive for a period corresponding to that consumed between the editing and the appearance of such a sheet. In direct proportion to the length of this period, it is necessary for the editor to turn away from immediate current events and seek inspiration elsewhere. Where does he get it? Why do we find in one issue a more or less humorous discussion, say, of the current vogue in soap advertising, while the next is featured by a serious diatribe upon present tendencies in battleship design? Why is this week's issue marked by a complaint against the too free use of alarming danger signs at points on our highways where only one bent on suicide could achieve an accident, and next week's by a hearty endorsement of the tendencies and achievements of modern electrical research?

The thoughtful reader must long since have reached the conclusion that the editorial page represents more or less a reflection of the editor's experience from day to day and from week to week. This would have been strictly true a century, perhaps even a quarter century, ago; today it is not strictly accurate. The mail brings into the modern editorial sanctum the press-agented epitome of the daily experiences of thousands of other people, who are for some reason interested in getting before the public those experiences, the views to which they have led, or the results which they have brought out. But this does not change the argument, really; it merely multiplies the editor by ten or a hundred or a thousand.

Ultimately the subject for editorial discussion must come out of the editorial mind, or out of some mind that has impressed its condition upon the editor's. The things that are uppermost in this mind are the things that come most easily to the surface and boil off in the shape of "copy." The philosophical discussion of soap advertisements can come only from one who has read a few soap advertisements with a seeing eye, an interested and inquiring mind. The harangue on the battleship of yesterday, today and tomorrow can come only from one who knows something about battleships, cares something about battleships, and has had battleships presented to his attention at some time in the immediate present. The expression of disgust at the manner of placarding our highways can only come from one who has very recently slowed to a snail's pace, in anticipation of a curve or a hill or a railroad crossing on which extreme danger lurks concealed, only to find that he has been deceived.

And so it goes. Whenever you read an editorial that is more or less in the nature of an essay, more or less dissociated from what the news columns have put before you recently, you may be sure that the editor's daily life is peeping out at you, or at least that some one's else daily life is revealed through the agency of the editor's mail basket.

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Electricity

A New Sign Lamp, especially intended for electric sign work, has just made its appearance. This 10-watt clear nitrogen-filled lamp serves well its intended purpose, so we are informed. It is a blue-glass lamp, and is a very decided improvement over the usual lamp employed for sign purposes, inasmuch as it gives a dazzling blue-white light with a minimum consumption of current.

Concentrated Heat. — Electric heating is gaining ground steadily, not so much in the home as in the industries, where concentrated heat is required. In fact, there is no other form of heat that can be applied with the preciseness of electric heat, and localized heating of parts of machines and equipment is fast come to be an almost exclusively electrical field. Several of the large electric companies are now making heating units for localized heat, and the consequence of such concentrated heat is an economical use of electric current.

Induction Motor with Double-Cage Rotor.—We learn from the *Elektro-technische Zietschrift* that a Cologne firm has placed on the market a double motor with two distinct stators and two cage armatures with copper rods going through both motors, connected in the middle by two high-resistance alloy strips. The two motors are incased in a single shell casting which contains an entrance and an exit flange for cooling air, the rods between the two armatures acting as an excellent air impeller. On top of the motor is mounted a controller switch with seven points, permitting as many economical speeds and torques, without the use of any resistance, by simple combinations of the two stators in delta-star series and parallel. Torque, efficiency and speed curves of this interesting motor are given.

Electric Cannon.—A great variety of electric cannon, based upon electromagnetic principles, ejecting a steel shell through one or more solenoids, have been developed from time to time but with no practical results. A French engineer, Fauchon-Villeplee, has worked out a new type of electric cannon which is described in *Revue Generale de l'Electricite.* The basic principle of the new gun is the fact that a current-carrying movable conductor will travel across a strong magnetic field. The author built during the war a model of such a gun, which shot a 50-gram projectile at a muzzle velocity of 200 meters, piercing easily a large hard-wood block. The author directs attention to the fact that because the gun windings are used for only a fraction of a second, enormous amounts of current may be used—of the order of 100,000 amperes and over—and supplied by a flywheel dynamo or a storage battery.

Bringing the Lamp to the Cleaner.—The best lamp made soon loses its efficiency if it is not cleaned at frequent intervals. Hence one of the regular jobs about any industrial plant that has any pretensions to efficient operation, is to clean the lamps and reflectors at regular intervals. In order to simplify this work, there has lately been placed on the market a safety disconnecting hanger, as it is called, which enables high lamps to be lowered away from electrical contact and dangerous moving machinery for cleaning and renewals. With this device in use one man can do the work of three in keeping the fixtures clean and helping the many large industrial lamps to perform the duty for which they were designed. The safety disconnecting hanger holds the lamp in place, but for purposes of cleaning or lamp renewal the reflector and socket, disconnecting automatically from the source of current, can be lowered by releasing a conveniently located chain.

New York-Chicago Telephone Cable.—The installation of an important aerial telephone cable between New York and Chicago is rapidly progressing, the American Telephone and Telegraph Company reporting that the New York-Pittsburgh section will be ready for service the latter part of this year. This long cable has not been made possible by only one or two developments, but by the coordination of diverse forms of apparatus and equipment. For instance, continues *Electrical World,* besides the vacuum tube and loading coil, which have furnished great help in the development, there have been the quadded cable phantom repeating coils, two-wire and four-wire repeater circuits, new telephone signaling and telegraph systems, composite sets permitting simultaneous telephone and telegraph messages and special types of aerial construction. The cable used in this line will provide 220 to 290 telephone circuits and 175 to 200 telegraph circuits, or the equivalent of eight open-wire pole lines. The project is particularly interesting in view of the rugged country traversed and the construction methods required.

Science

The Speed of Glaciers.—Studying Alaskan glaciers, Prof. W. S. Cooper finds that Muir Glacier has receded 60 miles in the last 127 years.

An Old Temple.—At Sicyon, near Corinth, the foundations of a great Doric temple, probably dedicated to Artemis, have been uncovered.

Free Course in Shoemaking.—The New York Board of Education offers a free, practical course in the manufacture of boots and shoes to boys over 14 years of age.

Farewell to Fairy Stories.—A Bolshevik decree forbids mention of fairies, angels and devils in books for children. Scientists take the place of the angels, and "princely heroes" are painted as oppressors of the poor.

Hot-Headed Londoners.—A thermometer, suspended for ten minutes inside the conventional silk hat of a London pedestrian, registered 107 degrees. The Londoner still clings to these heat-traps and pays in discomfort for his pride.

Guns Aid Antiquarians.—The concussion of anti-aircraft guns cracked the plaster of a font in a church near Sittingbourne, England, revealing an inner font of lead in fine preservation, an example of 12th-century continental workmanship.

World's Shorthand Champion.—The world sees its youngest champion shorthand writer in Albert Schneider, 20 years old, of New York. He wrote 175 words a minute without a single error, 200 words a minute with 12 errors, 240 words with 22 errors, and 280 words with 44 mistakes.

Sealing Fruit with Gummed Paper.—When gummed paper tape is used to seal fibre containers in which apples, melons, peaches, and citrous and other fruits are shipped, these are kept in a fresh condition for a much longer time, the actual extension of time depending on the kind of fruit. This was determined by experiments in car lot shipments.

Alpine Accidents.—From April 1st to mid-August, in North Tirol, 28 climbers lost their lives and 76 suffered severe injuries. Prominent names are among the killed and missing. Three men ascending the Dent du Midi were struck by a huge falling boulder; one was killed, another pinned down by the leg; the third secured help after five hours; it was then found necessary to blast the boulder to release the victim, which took another two hours.

Rumford Fund Awards.—The Proceedings of the American Academy of Arts and Sciences (No. 10, Vol. 56) has a complete list of its awards and grants from the Rumford Fund for Research in Light and Heat Forms. The first award went to Robert Hare for his oxyhydrogen blowpipe in 1839, and the latest to Irving Langmuir for his researches in thermionic phenomena, in 1920. Between these early and late awards many illustrious names appear.

Sunlight Ages Clothes.—Rain, air, mechanical strain and bacterial action all shorten the life of clothing, but sunlight is its worst enemy. Cotton and linen are more resistant to the deleterious rays than silk and wool, dark fabrics escape longer than light ones, and coarse material longer than fine. On the other hand, dyes fade more rapidly in cotton than in wool. Clothes should be brushed frequently, and when not in use should be put away in a dark place.

The Mechanism of Glaciers.—In tunneling through glaciers during the Alpine operations of the war, opportunity was offered for observations of inner structure and movements. In shallow cuttings, characteristics only to be expected at much greater depths were found. The alternation of lighter and denser layers cannot here be caused by pressure, but must be a primary, sedimentary formation. Interior crevasses often ended in a plane of stratification, thus pointing to the importance of such planes in the glacier mechanism.

Medical Fees Restricted.—The Johns Hopkins Hospital has limited its charge for medical attention to $35 per week and has made $1000 the maximum charge for an operation. Hitherto the medico has favored the poor and recouped from the wealthy; a certain clinic, for example, is said to ascertain the patient's income and tax it 10 per cent. Objectors to the new plan believe it will result in higher charges to the poor. Dean Williams makes a statement defending the Hospital's course, pointing out that it is a philanthropic educational institution; that the new rules stress the altruistic ideal of the profession; and that, since but 1-5 of its 900 beds will be available for private patients, there is no danger of the thrifty rich excluding the poor. Moreover the authorities may, at their discretion, allow a higher remuneration than the new rules provide for.

Wild Life

The John Burroughs Memorial Association has been organized to protect his homes and camps and to preserve them, with their wild life, for future generations.

A Golf Story from Canada.—Ontario squirrels are apparently mistaking golf balls for nuts. A Carleton Place golfer found 41 balls in one hollow tree, and further search of the squirrels' caches revealed 50 more lost balls.

A Pigeon's Record Flight.—A pigeon from the Government's loft at Beltsville, Md., delivered a message from Mayor Thompson, of Chicago, to President Harding in 16 hours actual flying time for the 614½ miles, breaking all former records.

Steel Jaws Are Cruel.—One-fourth of the animals caught by steel traps are worthless; 15 per cent escape by chewing off a leg. Many are eaten by other animals; all suffer lingering torture. The American Humane Society offers prizes aggregating $300 for the best essays acquainting the public with this cruelty and showing how it may be remedied.

Life Histories of Fishes.—In spite of a depletion of 36 per cent in his technical staff, the Commissioner of Fisheries reports notable progress in biological investigation. Much has been added to our knowledge of the lives and migrations of the Pacific coast salmon, of the paddlefish and smelts, of the whitefish and ciscoes of the Great Lakes, and of diseases of fishes in the St. Lawrence.

Snakes as Source of Profit.—Near Brownsville, Texas, W. A. King conducts one of the largest snake farms in the world, with a hundred hatchers constantly employed. The farm supplies specimens to museums and poison to chemists and medical men. Each rattler yields about a fourth of a fumblerful of the deadly green liquid. Snake oil, as a remedy for rheumatism, brings a good price, and hides and rattles are used in the manufacture of novelties.

Jersey Mosquitoes.—The annual report of the State Department of Conservation and Development declares that extermination of the mosquito would, in 20 years, add $500,000,000 to the State's industrial values, and that a 5-year campaign costing less than a million would eliminate the pest for all time. Disease-bearing mosquitoes, local and not numerous, are readily controlled by local efforts. On the present scale of appropriations, it will require 15 years to banish this pest.

Campaign Against Rabbits.—Since January, Grant county, Washington, has held 25 rabbit drives with a total of 98,050 killed. The rabbits ate up 4,000 acres of grain this summer at Moses Lake. In six months the Department of Agriculture distributed, free, 600 ounces of strychnine, and one ounce of this poison destroyed 1329 rabbits in a single field. There is a movement for winter shipment of frozen rabbits to cities for free distribution among the poor.

Zebu on the Paris Menu.—"Peau de zebu" is French slang for "worthless." Now Parisians have for some time been eating zebu, or Indian bullock, without knowing it. In their search for cheap meat the authorities discovered that the flesh of the zebu loses its stringy character and flat taste when the animals are reared in the French colony of Madagascar, and freightage from there is much less than from America or Australia. They now fear that this slang phase may give the meat a bad name—or odor, and that Paris may refuse to eat it.

Reactions of Turtles to Color.—Marine turtles lay their eggs on dry land, and as soon as the youngsters are hatched they make straight for the sea. Carnegie Institute men in the Dry Tortugas sought to find the influence that guided them to the water. When a sheet of red or yellow paper was placed between the baby turtle and the sea, it would turn and go in another direction; but a blue sheet drew him toward it no matter where it was placed. It would seem, then, to be color, rather than instinct or smell, that attracts the youngsters to the water.

Pests, or Benefactors?—What is evil under one set of circumstances may be good in another, as the latest report of the Biological Survey strikingly illustrates. Coyotes, we learn, are the most effective in keeping the plague of rabbits within limits; but the coyote in another aspect is so evil that we have put a price on his head. The meadow lark is a pest, in that it destroys sprouting oats,—a benefactor, in that it is a ravenous eater of grasshoppers. The benefit of turning pond-holes into cranberry swamps results in the evil of low ponds and less fishes. Wherever civilization turns it is confronted by that inexorable dictum: "For every gain, a loss; for every loss, a gain." Sane compromise is our only salvation.

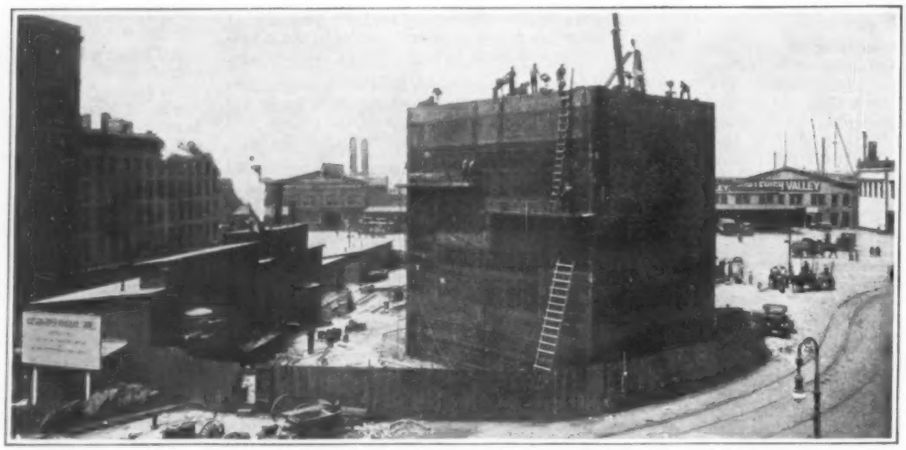
The Hudson River Caissons

Giant Shafts from Which the Vehicular Tunnel Will Be Built and Later Ventilated

By Robert G. Skerrett

THE Hudson River Vehicular Tunnel has been advanced a structural step by the recent completion of the sinking of two great caissons at the Manhattan terminals of the undertaking in the neighborhood of Spring and of Washington Streets. These caissons are next to serve as points of departure for the driving of the twin subaqueous tubes, and, finally, they will form permanent ventilating shafts.

Because of their magnitude and the proximity of business buildings, the execution of this work has demanded a goodly measure of skill, and, as might be expected, the aim has been to get the caissons down into position well below the ground-water line without endangering the adjacent structures. Further, the desire has been to minimize as far as practicable recourse to rather expensive underpinning in order to secure these buildings against settlement. These results have been realized by a somewhat novel departure in the sinking method adopted.



The Canal Street caisson during the riveting-up period preparatory to the sinking process

For the sake of those persons that may be interested in dimensional data, let it be said that the caissons measure, each, in cross section 47 feet by 42 feet 4 inches—the Spring Street caisson has a span from top to bottom of 53 feet 7 inches and the Canal Street one has a total height of 60 feet. The depth of submergence below the level of the pavement is 3 feet in each case—this brings the tops of the caissons to a point a short distance above mean high water. It should be apparent that the sinking of these gigantic boxes of steel has necessitated the excavation of much earth in order to get their cutting edges down to their present resting places in a stratum of sand. In connection with the Canal Street caisson it was needful to break a way through the interposed cribbing of an old dock. This is suggestive of how the Hudson River waterfront of Manhattan has changed in the course of time, for the modern bulkhead line of the city piers lies quite 250 feet further riverward to the west.

Taking them all in all, these caissons are bulkier structures than those of a kindred character previously sunk for railway tubes under either the East or the Hudson Rivers, and yet they have been got into place with marked celerity. For instance, the rate of sinking at Spring Street has been 2.69 feet a day while at Canal Street progress downward was 4.84 feet a day. At Clark Street, Brooklyn, where the material to be penetrated was the same as at the sites of the two vehicular tunnel shafts, subsidence averaged 2.94 feet daily and 68 cubic yards of earth had to be removed with each foot of settlement. On the other hand substantially 74 cubic yards had to be got out of the way to effect a similar descent in either of the more recent undertakings.

The procedure adopted was identical for both of the vehicular tunnel caissons. To be specific, a pit was first dug 10 feet deep and dimensioned to correspond to the cross section of the caisson, and in this excavation, which reached down to ground water, the steel frame of the caisson was erected and the plating riveted into place. When completed, compressed air was applied from an associate air plant installed for the purpose, and the actual process of sinking was started. This consisted in removing the earth lying within the area bounded by the four cutting edges of the rectangular structure and then in hoisting the spoils surfaceward through two tubes equipped at their upper ends with suitable air-locks. The lower chamber of the caisson was, in effect, a diving bell, and the function of the compressed air was to hold the outlying water at bay so that the sand-hogs could clear away the exposed muck, rock, etc.

As is pretty well known, ordinary caisson sinking in forming foundations for skyscrapers, bridge piers, etc., entails rather rigorous treatment of the men when passing up or down through the muck lock, for precious little time is given them for readjustment to the changing air pressures. Further, because of their limited size, the muck locks can accommodate only a few operatives at a time—a feature likely to involve peril in case of an accident calling for the speedy exit of a whole crew. To minimize this hazard and otherwise to provide better for the physical wellbeing of all concerned, the vehicular tunnel caissons were fitted with what is termed a T-head lock which was set between the two muck locks of each structure and linked with the working chamber by an independent hoist or tube. This special lock was elliptical in cross section, being 3 feet wide by 4½ feet high, and 20 feet long. A bench extended along each side, and there was room enough within for the simultaneous occupancy of a whole shift or working gang of fifteen men. This made it possible for the outbound or the ingoing crew to undergo deliberate decompression or compression, as circumstances required, and thus obviated subjecting them to sudden alterations of pressure which frequently induce more or less serious physiological disturbances. The T-head locks as well as the muck locks were so placed that they were always above the water line; and this served as a safeguard in case the air supply failed or it was no longer feasible to maintain a sufficient pressure.

In sinking the caissons the maximum air pressures employed were 22½ pounds for the Spring Street caisson and 27½ pounds in getting the Canal Street structure down to its deeper resting place. Operative air was furnished by a battery of compressors capable of providing 2800 cubic feet of air per minute. In other words, this was the buoyant impulse which sustained the gradually descending caissons and, incidentally, kept out the outlying water. And now we come to the most ticklish phase of the entire job.

As may be readily grasped, the settling caissons resembled in principle the downward motion of gigantic pump pistons owing to the close fit of the contiguous walls of earth and to the fact that water enveloped them on four sides. One of these caissons was sunk only 20 feet away from the foundations of neighboring buildings and reached to depths considerably below the lower limits of these adjacent substructures. It was imperative that counterbalancing air pressures should be brought into play so cautiously and skilfully that the movement of the caissons would not provoke reactions of the ground water that would be likely to wash out or cause the displacement of the soil sustaining the weight of the near-by business edifices.

Each pound of air pressure applied within the working chamber of either caisson produced a buoyant or uplifting movement of about 144 tons, carrying the caisson's weight in large measure and incidentally prevented the outlying water from rushing into the chamber. Conversely, had the air pressure dropped suddenly there would have been a corresponding invasion of the surrounding water and a coincident undermining of the walls of the pit. Such an erosive action would have menaced the property flanking the excavations. The problem was intensified with each foot of sinking, because the added air pressures required exerted a greater force upward. Had this reached a point where it actually could have raised the caisson, the consequent suction or inward flow of the water would have been akin to that provoked by an abrupt drop in pressure within the working chamber. To combat this peril the expedient was adopted of loading the upper section of each caisson with a compensating amount of muck, and this gradual augmenting of the caisson's deadweight effectually neutralized the uplifting impulse of the increasing air pressure.

The Spring Street caisson, from above, at an early stage during its sinking

Uncle Sam's Big Camera

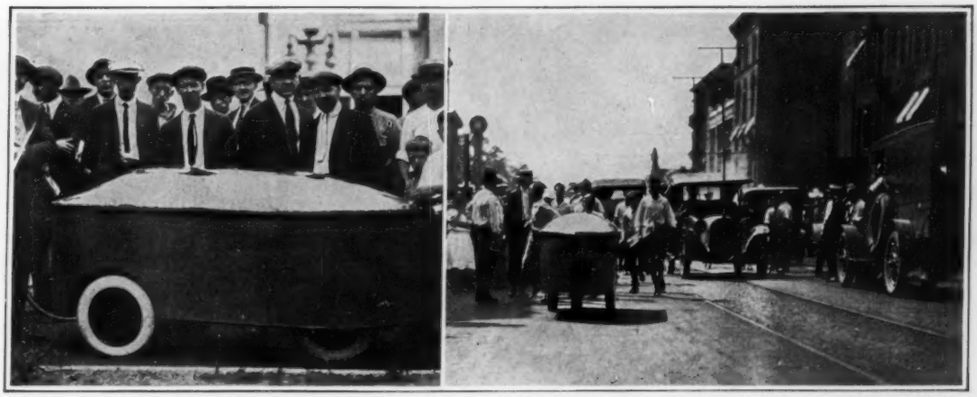
IN the monster camera just installed in the United States Geological Survey professionals and amateurs alike are sure to be interested. Great as has been the ingenuity displayed during the intervening years since Thomas Wedgwood first discovered that pictures could be produced by the action of light on a sensitive surface, none seems to have so completely filled the need in copying processes as this novel prismatic camera. Designed by A. H. Linsenmeyer, the Survey's leading photographer, the three-and-a-half-ton giant, hanging from the ceiling, dispenses with the perplexing problems of alinement, focusing, etc., and responds to direction by electricity or by hand more readily than does the tiny kodak to the grasp of a steady pair of fists. Nowhere are higher standards of accuracy maintained than in the Federal Survey, and that absolute scale is secured in the reproduction of every map is due largely to the fact that the big machine is exact in every movement to the smallest fraction of an inch.

Save for the bellows and curtain-slide, which are of rubber, the camera is an all-metal affair. Flexure and distortion of image—faults which are common to the ordinary make—are unknown to this marvel of the picture world. A rigid tubular steel frame, ten by sixteen feet, is suspended from the ceiling by springs so attached as to offset any possible vibration of the building. From this massive frame hang the several parts of the camera, in the operation of which the usual method of copying is reversed. In one corner is the plate-holder, projecting a ways into the darkroom. In front of this is the bellows, terminating in lens and prism, attached to a carriage which moves on two parallel rod-rails. Resting on this carriage and traveling at right angles is a second carriage supporting the copy-holder. And here is where the process differs from the ordinary practice; the lens and copy-holder move toward or away from each other, according to the size and scale of map desired, but the plate-holder remains stationary inside the darkroom. This dispenses with the constant squaring up of camera and copy-holder and practically eliminates the time-consuming operation of focusing. The lens is moved forward or backward by the motion of the first carriage, which opens and closes the bellows in accordion-like fashion. The uniformity of bellows movement is regulated by lazy-tongs on either side which give the camera front the appearance of a huge jack-in-the-box.

As previously pointed out, the plate-holder of the marvelous machine is firmly attached to the main frame and extends into the darkroom. It has an automatic plate-centering device, aluminum drip-trough, half-tone screen-holder, screen-distance-regulator, spring support for holding the plate in position, and a rubber curtain which keeps out the light during exposure. Just beneath the plate-holder are four hand-wheels which make one think of a pilot-house. Two of the four function the lens, giving it horizontal or vertical motion as you will. The others move the bellows and regulate the matter of copy distance. All four wheels are connected by chain gear to square revolving rods, along which slide bevel gears, an assembly which permits motion to be communicated to the gears at any point in their travel. And if the photographer chooses to operate the machine from the darkroom, he can peep through a little red window and watch the copy-holder and lens swing into position for the picture.

This is a steel frame carrying two heavy glass plates, four by six feet. The copy is placed between them; but perhaps you are wondering how, for the illustration seems to have them permanently fixed. This is true as regards the front plate, which is ever in correct alignment with the lens and plate-holder. The rear glass, however, drops back from the top, bookwise, when you turn a hand-wheel at the side of the frame. This releases eight felt-covered cams (four on each side of the frame) and when the copy is inserted, either from the top or from the side, the wheel is again turned and the rear plate is jammed against the front. If perchance the copy should fall between the glasses at the bottom, the operator can "fish" it out with spe-

(*Continued on page 263*)



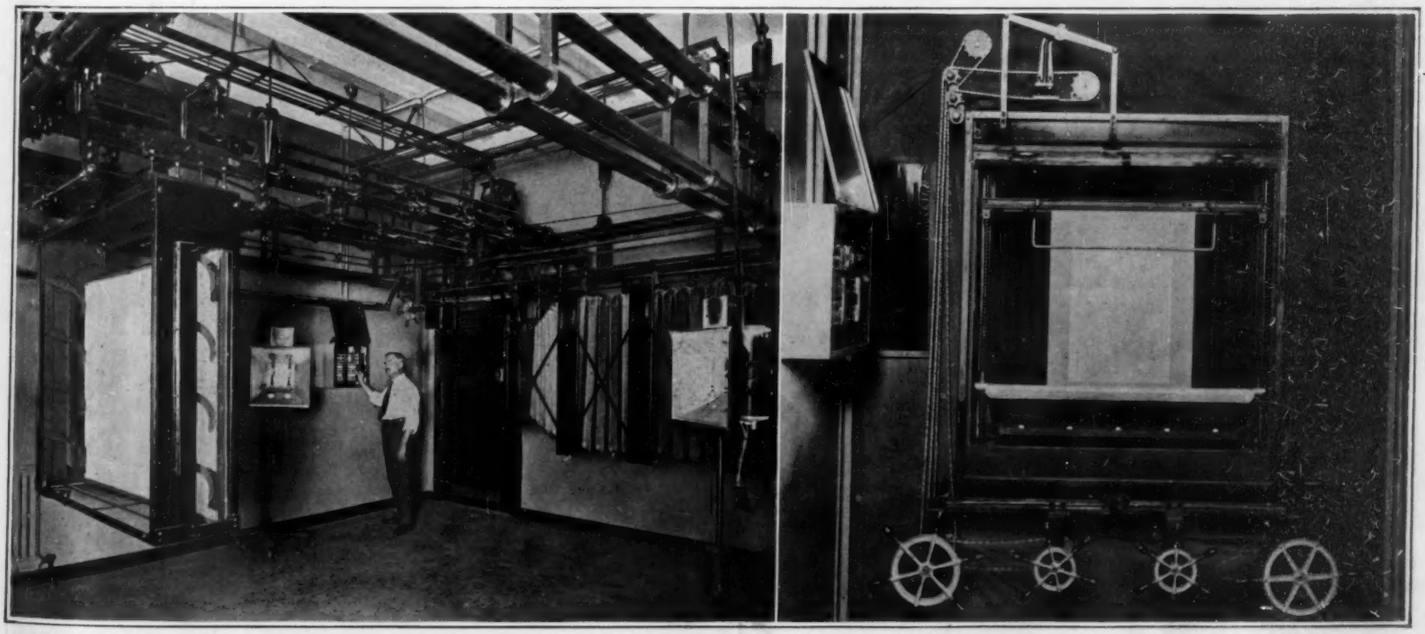
The radio-controlled car recently developed by the Engineering Division of the Air Service at McCook Field, Dayton, Ohio, standing still and under way

Radio-Controlled Automobile

RECENT visitors at McCook Field, the home of the Engineering Division of the Air Service at Dayton, Ohio, have been astonished at the gyrations of a brightly painted three-wheeled vehicle which has been dashing to and fro between the buildings and among the airplanes on the field under no visible means of control. It is often seen to approach a group of persons blowing its horn wildly, and then when apparently about to strike them, to stop short with screeching brakes, back up with loudly clanging blow, make a sharp turn to the right or left, and to start off in the opposite direction. Great mystification has been shown as to the method of operation of this car, some visitors even wondering if perhaps a combination of weather and newly made home brew may not have had a deleterious effect upon their observational powers. They are ofttimes considerably relieved to learn that the car is actually performing as they have seen it, though the mystery is lessened but slightly when they learn that the movements of the car are controlled entirely by wireless signals, which are sent out from the radio station at the opposite end of the flying field. The fact that there is no aerial or antenna system visible merely adds to the mystification.

The car is of cigar-shaped construction, about 8 feet long and runs on three pneumatic-tired wheels. It travels at speeds ranging from 4 miles per hour to 10 miles per hour and the controls are so finely adjusted that it may be easily steered along a narrow road-way.

An examination of the interior of the car shows an amusing and confusing collection of batteries, switches, wires, vacuum tubes, potentiometers, relays, magnetos, etc., all of which are, of course, necessary to the complete control of the apparatus. The most interesting part of the apparatus is the "selector" which is in reality the heart of the entire control system. Various combinations of dots and dashes are sent out by means of a specially constructed transmitter, each combination calling for the accomplishment of a certain operation of the control apparatus. It is the function of this selector to "Decode" these various combinations of dots and dashes which are sent out, and to close the circuits to the desired controls. The selector makes it possible to put into operation any one of 12 distant controls in less than one second.



Left: **Operating the new prismatic-process copying-camera from the electric switchboard.** ***Right:*** **Plate-holder, seen from behind the instrument, inside the dark room**

Coloring a model of an invertebrate with an air brush

Mr. Dwight Franklin Modeling a lizard

Making artificial seaweed from celluloid

Behind the Exhibits

Departments and Activities of a Museum Which the Layman Never Sees

By Albert A. Hopkins

As we roam through the halls of a great museum we are prone to think that the exhibits require little preparation before they are shown to the public. The very reverse is the fact, and a few astounding statements can be made which may not be true for all museums, yet are correct for the greatest of them all, the American Museum of Natural History. In the first place, about four-fifths of the material is in storage, not necessarily boxed up and piled in storerooms, but arranged in fireproof, dustless rooms, cases, presses, and other containers. The rooms seem endless; yet if a student really wants to see bird skins, aboriginal skulls, prehistoric stone implements, etc., he will find a collection so extensive that the volume is almost appalling.

For example, the ethnological collection embraces 100,000 catalogued specimens. There are 2000 human crania, 500,000 insects, 150,000 bird skins, 100,000 invertebrates from one expedition, and so on. It might well be asked why only twenty per cent of the objects acquired are shown. The answer is simple; for in the case of Natural History the vast majority of the specimens are in the study series, not only because they would ultimately be ruined by exposure to light, but because the display of all material would only confuse the visitor. Moreover, no museum has room to show everything, and a careful selection is made of objects of the greatest educational value. These are so displayed as to enhance their interest and attractiveness. The aims of a museum of natural history are multifold and might be defined as follows:

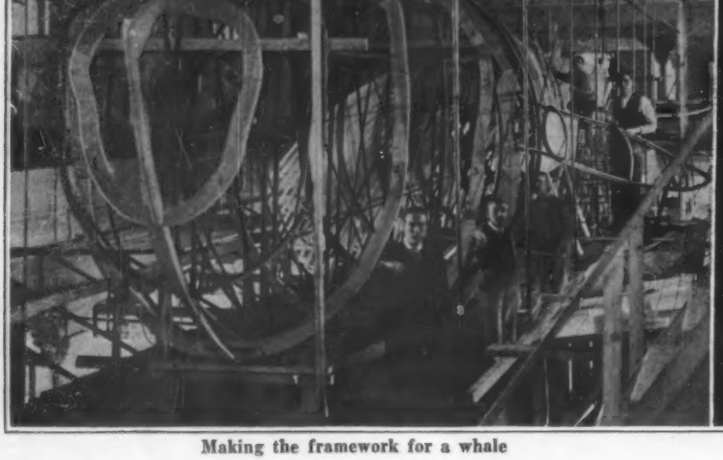
The purposes of a great national museum of natural history are: (1) To procure by its own explorers or by the voluntary assistance of independent naturalists the actual specimens upon which accurate knowledge of the animals, plants, and minerals of the earth's surface, and more especially of the national territory, is based; to preserve and arrange these collections for study by all expert naturalists, and to facilitate, directly or indirectly, the publication (in the form of catalogues or monographs) of the knowledge so obtained, with a view to its utilization, not only in the progress of science, but in the service of the State. (2) To exhibit in the best possible way for the edification of the public, at whose charges these collections are made and maintained, such specimens as are fitted for exposure in public galleries, with a view to the intelligent and willing participation of the people in the maintenance of the museum. As the museum is emphatically "for the people," special attention is given to making the exhibits attractive and interesting, as well as instructive.

While the American Museum of Natural History cannot claim to have originated the idea of displaying animals amid their natural surroundings, it was the first large museum in the country to adopt this method which it has since carried out on a large scale in the well-known "habitat" groups. In the museum were also developed the methods of preparing and mounting the skeletons of extinct animals that have resulted in such mounts as *Brontosaurus* and *Tyrannosaurus*, and the series showing the development of the horse, so that they might be something more than an assemblage of uninteresting bones.

It is with the greatest liberality that this museum gives the results of special methods of preparation to the scientific world, and while the great public, to the use of which the great structure is so largely dedicated, cannot, of course, be admitted to the laboratories and preparation rooms, yet our readers will be enabled to visit pictorially, at least, these veritable hives of scientific industry. With the permission of the Director, Dr. Lucas, and under the guidance of Mr. Miner, Associate Curator of lower invertebrates, the writer spent a most fascinating day in the huge building, which is, by the bye, 710 feet long.

In the basement is located some of the shops which require considerable space, as the carpenter shop, where cases of all kinds are made as well as the wonderful queer-shaped pieces of wood for the "insides" of animals, called "armatures." The Museum staff have designed cases and moth-proof containers of all kinds which show great inventive skill. In the Museum of the old school, and there are many of these, the objects were exhibited in a cold, formal way, out of contact with the real environment, and the skin was painfully stitched to gunny sacking covering the skeleton. The skin was distended by the judicious use of sawdust. Now all is different. A field staff goes to Africa. They are extremely versatile, some study the jungle; some study the rocks; others photograph or make color studies; while still others spend their time in investigating the habits of the huge animal who is unknowingly facing the bullet from the elephant-gun of the naturalist-hunter.

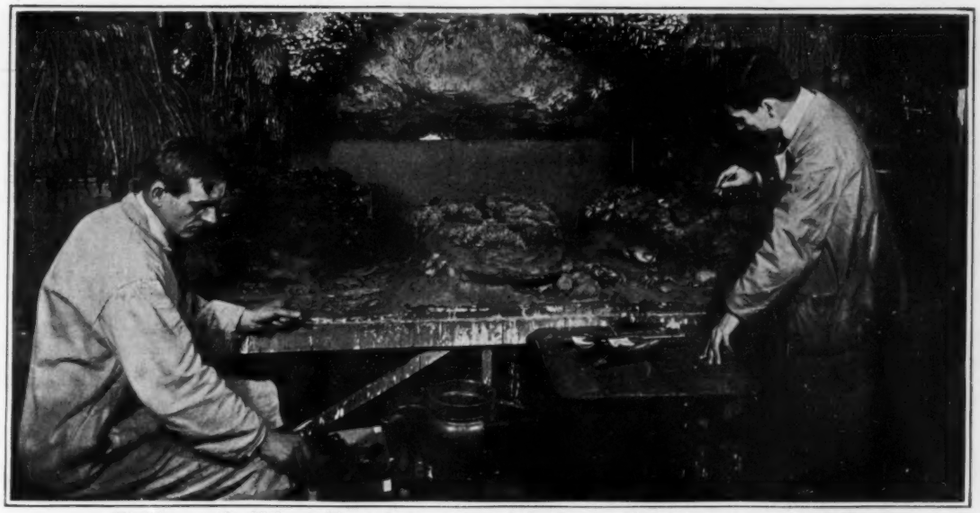
The skin and bones are preserved and are shipped home. A year or so later the staff members reassemble and begin to visualize what they have seen in far-away Africa. They build an artificial jungle of wire, wax, celluloid, glass, and the thousand and one articles which these up-to-date "preparators" consume, for the old-time taxidermist is in the discard. The artist paints the background; the sculptor models in clay the great



Making the framework for a whale

Trying on a skin over a modeled body

bulk of the figure; plaster casts are made, using an artificial framework of wood and iron to take the place of the bones which are being boiled clean in an adjoining laboratory before they are articulated. Then comes the "trying-on" process in which the hide is fitted to the new body, and, finally comes the glass blower who takes proper notes for the eyes. In due course the public is admitted to see the completed product. Labeling comes later, for a museum's labels cannot be made hurriedly. The time and care lavished on labels are almost beyond belief; a set of labels often takes two years in the preparation. With birds or butterflies the method of procedure is the same, and the wonderful bird groups have been the delight of thousands. The same general plan is adopted throughout the other fields of endeavor, such as ethnology, anthropology, geology, palaeontology, and mineralogy.



Working on the Nahant tide pool group, one of the finest marine groups ever attempted

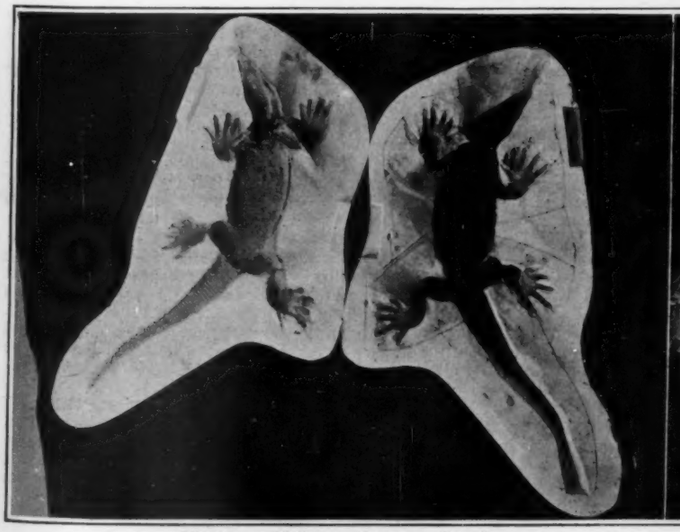
In the palaeontological portion of the geological field the specimens begin to be prepared in the locality where the find occurs. The fossils are covered with plaster of paris and gunny sacking, together with a sufficient quantity of the gang-rock to insure the great or less integrity of the remains. On arriving at New York, the bones are carefully removed from the matrix and a huge flexible drill, like a gigantic dental engine, serves to fit the various bones together. The gaps are finally filled in and the huge articulated extinct animal stands out in three dimensions, or flat against a slab. Progress photographs are constantly being taken so that an imperishable record is made of the way it was all done.

Wax flowers enter into nearly all of the groups, and it was found necessary to invent a whole new process, which will form the subject of a subsequent article. Sometimes tin flowers are required, and the museum has to have a tinsmith who can make anything. The glass blower is an important artisan, we might almost say artist; his services are constantly required, especially for making models of insects, invertebrates, etc., and he is all-essential when marine groups are being made.

This brings us to, perhaps, the most interesting phase of this fascinating subject—the invertebrate groups, which are gradually spreading from window to window in Darwin Hall. This series portrays the invertebrates in their natural surroundings, and serve to emphasize certain biological principles which cannot be enlarged upon here further than to say that these groups illustrate within themselves all those laws which lie at the basis of the doctrine of evolution, to the presentation of which Darwin Hall is dedicated. The making of these groups requires years of time. Hundreds of studies may be made in the field, from the objects themselves often drawn from observation under water, or under the microscope. These studies are by various hands and are allowed to accumulate for four or five years when the actual work of preparation is begun. The general physical presentation is discussed and small models like those designed by stage directors are made. After all ideas have been carefully threshed out, each one begins the fabrication of his part. One man takes crabs, for instance, removes the body from the shell; models a new body; puts it back in the shell; articulates legs and claws and paints—for all time—the colors which were all too-evanescent in its brief life on the sandy bottom. Then there is a whelk, a hermit crab, and a snail; all are treated in the same way. There is eel grass to be cut out of sheet celluloid colored by hand and with the airbrush. Meantime the artist has been painting the background on successive sheets of glass which are constantly being tested for the effect. The making of seaweed is a large order; but with punches of a half dozen different designs this part of the work goes quickly enough. The specimens are studied in siter and photographs and drawings brought down from Wood's Hole, or elsewhere, and the next operation is to fix them permanently in wax or glass; for organic matter will decompose quickly, or if preserved in alcohol becomes so deformed and bleached that it is a travesty of the living animal. The animal life, with the exception of hard structures, such as shells, is an assemblage of models.

The mussels on the piles are the actual specimens which were preserved in alcohol and afterward taken apart, the soft portions cleaned out and the shells reassembled with wax and cotton. The worm tubes are the natural dried specimens recolored. The starfish was also dried and prepared with a wax foundation, the tube feet being modeled in glass and inserted. The tubularian hydroids were all separately blown in glass and welded together in colonies, the sketches made in the field and the original alcoholic specimens being used as patterns. The color was sprayed on with the air brush, the finishing touches being made by hand in the usual manner with paints. Hundreds of tentacles for the sea anemones, cirri for the *serpulid Hydroides dianthus;* and even some of the seaweed are also the work of the glass blower, but perhaps the best work in this line is the modeling of the jellyfish and the squid. The former is entirely of glass and is a masterpiece of the glassblower's art, while the peculiar translucency of the squid's body could be obtained by no other medium. The coloring of these two models by the Japanese artist is also a triumph of skill. Much of the animal life, however, was modeled in such materials as wax and celluloid. A single exhibit may consist of 200,000 to 300,000 objects fashioned by the hand of man so that it is little wonder that three or four years is a little period when a group like this is considered. The expense which runs up into thousands is fully justified on account of the permanency of the exhibit which, with proper care, will be in existence long after our grandchildren have passed away. The bryozoa group is most popular, for we apparently look through a huge magnifying glass three feet in diameter, at a bit of the bottom of the sea where the seaweed is three feet high. Alice in Wonderland never saw such a queer assemblage of wax, glass and other objects; for everything is laid under contribution, and the effect is the same as if actually viewed with a magnifying glass of normal size. Another magnifying glass will show us pond life in a year or so as it is now in process of construction. We have dwelt particularly on the invertebrate groups, because of the invention which has been displayed by all these "habitat" groups, but particularly those dealing with the lower form of animal life; for though a bird or animal group may require painstaking labor and the skill of the sculptor they do not require as much invention and resourcefulness as do the lower invertebrate groups.

It might well be asked if the time and money which are expended are justified. It is, indeed, a wise expenditure of money for the creation of educational exhibits which will prove a delight to the people for a century or more to come.



Plaster mold for casting wax lizard

Making a clay mold for a model of a hippopotamus

The Science of Athletics

What Is It That Distinguishes the Star from the Mediocre Performer?

By Charles W. Paddock, Olympic Champion, 100 Meters

THERE are two characteristics which go to make an athlete, muscular development and nervous energy. It makes no difference how many other qualifications a man may have, if he does not possess both of these in at least some small degree, he will not make a success in any kind of competitive sport.

A man who already possesses natural physical strength has a distinct advantage over the man who is forced to develop it through a course of rigorous training. Because the man who is a born athlete, if he spends an equal amount of time in training himself, will become a super-athlete, and a champion. However, it is not impossible for a man to become a great athlete, even though he be handicapped by a poor physique in the beginning. Indeed, some of our greatest performers today are men who do not have the appearance of athletes, and yet possess an uncanny degree of strength in certain fields of physical endeavor.

Richmond W. Landon of Yale University, Olympic Champion in the high jump does not have the appearance of an athlete, yet he has so developed himself as to have a greater amount of spring in his legs, than any other jumper in the world. Morning, noon and night he skipped rope, jumped for imaginary apples, hung high on imaginary branches, until it became with him a habit to jump. Then when he first attempted leaping the high jump bar he wore heavy shoes and clothing, and when at last he was able to clear high heights in such garb, he donned a track suit and spikes, which gave him the lightsome feeling that so impresses the spectator who watches this slim, unathletic looking person clear heights which natural-born athletes dare not attempt. . . . But in golf and tennis, and more particularly in running, nervous energy is more important than muscular development. Its a question of nerves more than strength to sink a ten-foot put, when it means the match, or to avoid serving doubles in the game that means the set, or to get off with the field, in a short distance race where the start counts for everything.

There was a great sprinter in this country, recently retired, who was the fastest man from the mark among the great indoor track competitors. His perception of the starting pistol report was so lightning-fast that his muscles seemed to react to the sound of the gun, without any mental command on his own part. On the ordinary man who should start beside him he would probably have gained ten yards in the first twenty, while against the average track man he would easily gain two yards in that distance, and even the greatest opponents conceded two feet to his start because of that marvelous reaction of his. But this little fellow, Jackson V. Sholtz of the University of Missouri, had worked long and hard to gain this advantage. And it was not only the result of physical effort and practice, but was also due to the training to which he had subjected his nerves.

And herein lies the hope for the man of business of keen brain and unresponsive muscles. He can train himself even as Sholtz and Landon have done, to such a physical state that his muscles will react to his will, and though he may never have the strength of a Ralph Rose or the speed of a Jack Sholtz or the spring of a Dick Landon, yet he will have enough of that muscular development to pair with his nervous energy which he has gained, to become a champion athlete.

It has been said that a man cannot begin late in life to play any game and become a champion. But there is not very much to that theory. It has been upset too many times. It might apply to the gray-haired veteran who attempted to run a race or play football, but even then there have been so many exceptions the rule can hardly stand. Some of our greatest athletes never began until late in life, and not all our baseball players were born with the rawhide sphere in their hands. As for golf any man if he is physically fit, or can make himself so, can by practice become a 90 per cent man, and with sufficient handicap can win tournaments.

This training to become a champion does not take all of your time. Indeed, it consumes just enough to give a man the essential recreation which he needs for the pursuit of health. It can be engaged in so as to benefit business as well as physique, and when the practice days are past, you will have the satisfaction of feeling that you can conquer in competitive sport, which is one of the most satisfying of feelings.

The old theory used to be that in order to attain success in athletics a man could do nothing else but prepare himself for his own particular event to the exclusion of any other work. That idea does hold good, in that a man can really be a champion in only one athletic endeavor at a time. This is the age of specialization, no doubt of it, and if a man will take up one event and religiously perfect himself in it, he will certainly succeed. Of course there are a select few who can do a number of athletic feats well, and a few who have become stars in two or three different fields. Many college men become proficient in both football and track, but there are very few who become champions in more than one kind of competitive sport. The victory of Miss Mary Browne of California in the southern California Golf Championships coupled with her brilliant career in the world of tennis makes of her one of the most notable exceptions to the rule.

But outside of specialization the theory that a man can do nothing else but athletics, if he is an athlete, is incorrect. Indeed, athletics is similar to business in that the star performers in each field must have relaxation in the other in order to be at their best.

For several years the writer has been engaged in newspaper work and college studies and at the same time has been doing track work. The two have gone hand in hand, and each has been benefited by the other. Because of that need for relaxation, athletics was first taken up. In order to create a definite interest in daily exercise, one particular event was chosen, and it was made a specialty with the result that the real business of life was improved, and at the same time a new pleasure was created by watching the improvement of my work on the track.

The only difference between my training and that of any other athlete is the fact that within a week's notice, providing of course I have not been the victim of some illness, I could make myself ready to enter my hardest competition with every confidence of being at my best. That is the greatest pleasure of athletics, having the feeling that I am physically fit. So often athletes have found themselves in the worst possible physical condition within a few days after strenuous competition, because they have suffered reaction from training and gone to the other extreme of dissipation. But if a man pursue a moderate course and keeps himself in good condition at all times he will not have to train so strenuously just before a great contest, and therefore will not feel the need of breaking training immediately the ordeal is over.

In order that a man may not become weary of the particular sport wherein he is most adept, it is a good idea to engage in some other exercise part of the time, and only train in that certain field of athletics a few weeks before competition. For the first thing essential to success will be condition, physical condition. It makes no difference what manner of exercise you have taken so long as you are fit for the contest.

After gaining your condition, and by that I mean feeling strong and well, having strength and pep, and being able to engage in hard work in the daytime and sleeping well at night, the amount of practice which should be engaged in prior to a contest of course depends upon the amount of playing that has been done by the individual. For example if it were track, and the man had run several seasons, in high school and college competition, a couple of weeks' running and a week devoted to starting practice would be about all that was necessary, providing always the contestant was already in good physical condition.

If the athlete had never competed in that form of athletics before, or indeed had never taken an active part in any kind of competition, there are several methods of enjoyable exercise which should prove strengthening, particularly if the form of sport contemplated was of a strenuous nature. There is nothing which will develop a boy or young man so quickly or so well as swimming. Bicycle riding, too, if not engaged in too strenuously is wonderful exercise, and walking, along with either of these, furnishes a combination of muscular development hard to surpass. But if swimming is the form of sport the neophyte desired to perfect himself in, then a great deal of running would prove profitable. In the first place it is the direct opposite of swimming and develops an entirely different set of muscles. So that when the runner becomes a swimmer he can tell the progress he is making by the degree of soreness which he experiences. This soreness of course indicates that other muscles are being developed, and unless you swim a very great deal which is not good at first, then it will take you a much longer time to develop your muscles. Again, in swimming, it's your chest and shoulders and arm muscles which receive the most attention, and by running you have also developed leg muscles as well. When you become a champion, that extra development which the running gave you, will give you an advantage over the great swimmer, who never ran. And so the theory holds true in many kinds of competitive sport. Though you may specialize in only one, you may gain a great deal of assistance from the participation in other kinds of athletics.

Joie W. Ray, considered by many the greatest mile runner who ever lived, wins his races simply because he had development in another kind of sport before he became a long distance runner. Ray boxed a great deal when a boy, and developed a marvelous chest and lung capacity. He also had a splendid pair of legs.

The mile-race, as you know, is usually run on a quarter-mile track, and after the runners have circled the oval twice, Ray starts his sprint. All other milers wait until the fourth lap to begin running their hardest. So when they meet Ray, and he runs away from them in the third lap, they don't know what course to pursue. If they attempt to stay with him they may hold him for that lap, but when the fourth and last quarter is reached they have run their race, while the great reserve that Ray has gained from boxing enables him to fight it through to the end. On the other hand if the milers pursue their usual tactics, and wait until the fourth lap to sprint, though they may gain on him, Ray is so far ahead that they never can catch him.

Though boxing may help you in running, and running in swimming, and swimming in tennis, etc., the essential stuff of which champions are molded is confidence. It is produced by nervous energy and the belief that you surely can do the thing you set out to accomplish.

The right mental attitude is after all the most important part about athletics. Belief in yourself and in your own ability is certainly one of the foremost stepping stones to athletic success. If you have nervous energy and plenty of it, and a firm belief in yourself, you can develop the necessary muscles through practice in different forms of exercise to become a star in almost any branch of competitive sport for which you are fitted.

And it is not a question of eternal playing either. If within a few months you show no signs of improvement, then change to another kind of athletic activity, there are plenty of them, and keep changing until you do find yourself. Then stick to it, and if you get out only once a week, at least practice a little bit at home in the morning before business, or in the evening, when the day's work is done.

EVERYBODY must, at one time or another, have been puzzled to know just what it is that determines athletic ability. Jim Barnes, Ted Ray and Jock Hutchinson, for instance, three of the world's best golfers and three of the longest hitters, are of three diametrically opposed types: Barnes, extremely tall and willowy; Ray, built in every proportion like a truckhorse, and Hutchinson, just the reverse—short, slight, wiry. Every game offers similar contrasts—even a sprinter is sometimes found of gigantic or near-gigantic proportions, while a long distance champion may be small and apparently frail. Just what is it that these types possess in common that makes them champions? It is this question that Charlie Paddock, Olympic quarter-mile champion, has asked and to his own satisfaction at least answered in this article. It is merely, he insists, a case of subjecting the muscles, by intelligent training, to the complete domination of the will.—THE EDITOR.

High Pressure Steam

A New Departure in Power and Heating Plant Engineering

By Our Berlin Correspondent

IT had long been thought that the maximum efficiency possible at the present stage of steam power engineering could not to any material degree be improved upon. The best steam consumption figures ever recorded in engineering literature are probably those obtained by Heilmann with a Wolff locomobile (semi-stationary engine): 15.5 atmospheres, or about 230 pounds initial pressure and 465 degrees Centigrade, live-steam temperature, there were used only 3.3 kilograms of steam per indicated horsepower-hour, corresponding to a heat consumption of 2670 heat units.

That far better results can be obtained by the adoption of extremely high steam pressures has, however, been strikingly shown by Hartmann, who gave, at the recent Congress of German Engineers, an interesting account of the results achieved in this connection by Dr. Wilhelm Schmidt and his assistants.

When the adoption of steam pressures far exceeding those so far in use was first suggested, the attitude of engineers and scientists alike was skeptical. The results obtained in the course of ten years' operation of one high-pressure steam-boiler plant, as well as tests made on a number of high-pressure reciprocating engines, have shown this skepticism to be unfounded. In fact, it may now be affirmed that there is absolutely no objection to designing huge steam power plants for initial steam pressure up to 60 atmospheres (about 900 pounds to the square inch).

There are mainly two fields where "high pressure" steam, that is to say, steam of more than 30 atmospheres initial pressure, has so far been shown to be used with advantage: first, in power plants operated with condensing engines, and second, the more and more urgent linking up of power and heating plant engineering. Unexpectedly favorable results were obtained in both these fields. In one case, a condensing high-pressure reciprocating engine of about 145 indicated horsepower with 55 atmospheres initial pressure, 335 degrees Centigrade live steam temperature, a 95 per cent. vacuum and double intermediate superheating, was found to exhibit a working steam consumption of only 2.33 kilogram (5.13 pounds) per horsepower-hour and a heat consumption (inclusive of intermediate superheating) of 2,070 heat units, as reduced to a feed-water temperature of zero Centigrade. In the case of larger units, however, even better results may be anticipated.

When comparing these results with those referred to in the beginning, a saving of heat as high as 22 per cent. will be found to have been secured, while the opinion, still prevailing, that intermediate superheating insures no useful results, has been shown to be erroneous. In fact, a coal consumption of .366 kilogram per effective horsepower-hour can now be relied upon in the case of large units, with 80 per cent. boiler efficiency, using coal of 7,500 heat units per kilogram. In designing large high-pressure steam power plants, the upper part of the gradient should preferably be made use of in high-pressure reciprocating engines, the lower in low-pressure turbines. High-pressure condensing engines will mainly be used as driving engines for vessels.

The advantages of high-pressure steam in stationary plants are especially conspicuous in the linking up of power and heating plants. The lecturer, in the case of initial pressures exceeding 30 atmospheres (450 pounds), has observed a remarkable interaction between initial and back pressures. In fact, the specific steam consumption of unit capacity, with live steam tensions of 30 atmospheres and more, and back pressure rising to 10 atmospheres and more, was found only to increase as the back pressure. It will thus be possible without any material loss of energy to use higher back pressures than those hitherto employed, thus enabling operations such as vaporizing and heating, heretofore dependent on the use of live steam or the direct application of fire gases, to be carried out with exhaust steam. Moreover, any difficulties connected with the distance separating the steam generator from the place consuming the exhaust steam, will now readily be overcome, exhaust steam of higher tension being readily led to greater distances. Moreover, such exhaust steam of higher tension can more readily be stored in heat accumulators. The heat consumption, with, say, 60 atmospheres initial pressure and 3 atmospheres back pressure, will not exceed that of the best condensing engines so far in existence. At present, in the case of these engines, about 2300 heat units out of the 3,000 actually expended will go to the condenser cooling water, being in chimney coolers expelled into the air or wasted on the heating of rivers and ponds; whereas the high-pressure, back-pressure engines of equal output will enable the same heat to be used to advantage for heating purposes.

Distinctly novel points of view should, in the light of these results, be considered in the linking up of power and heating plants. The advantages of high-pressure steam are equally conspicuous in the case of reciprocating engines and steam turbines, high-pressure, back-pressure reciprocating engines having considerably smaller dimensions and requiring a lower initial outlay than the familiar types of condensing or back-pressure engine.

Coal Mines to be Developed in China

COAL reported to be of a very good quality has been found at Chiyanchow, Paipuchen, Chili Province, China, according to the *Far Eastern Review*. The Pekin-Mukden Railway Administration has decided to operate the mine with a capital of $5,000,000 Mex., with the view to making the line independent in fuel supply. A newly discovered coal field is also reported in Shantung Province, which is said to contain an immense quantity of smokeless coal. Chinese and foreign engineers were engaged in the exploration of the coal field, and the mine is to be developed under Chinese auspices at an expenditure of $500,000.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Super-Pneumatic Tube

To the Editor of the SCIENTIFIC AMERICAN:

Since the new postmaster-general sent out his invitation for suggestions for improved transportation I have renewed thought on an idea which I have had in mind for a long time, and that is a gigantic pneumatic tube system, even large enough to admit a cylindrical car for both passengers and mail. Have studied on this until I believe it may be the next and most feasible step in rapid transit.

With a groove in sides of tube for projection on car to serve the double purpose of steadying and as brake if counter-resistance of air was insufficient, and a resistance flange designed to overcome the friction problem, with block system to prevent any possibility of cars getting within a certain distance of each other, am sure a far greater speed than any airplane could be obtained, and greater—in fact perfect—safety assured—more perfect safety than any other system, and in no way dependent on the elements.

There would be ample hydroelectric power for air compressors, so no coal would be required. So while the first cost would probably be considerable, the operation would be very economical.

With the railroads almost obsolete and little possibility of airplanes ever being safe enough for the general public to have confidence in them, I believe this is worth considering. A. E. MORRILL.

Willimantic, Conn.

An Exchange of Lichens

To the Editor of the SCIENTIFIC AMERICAN:

The work I am engaged upon here takes me over a large portion of Southwest India ranging from sea level to an elevation of 7000 feet and including desert condition and tropical forest with an annual rainfall of 300 inches or more. Consequently I have at my command a very varied flora. I have always been an ardent amateur botanist and flowering plants are a hobby of mine. For some years I have been struck by the very varied Lichen flora of my district and I should be very glad to get into touch with someone who is interested in these plants. I should be prepared to collect and forward material under numbers if he in return would send me correct names for my duplicate collection and when a good list had been made I should propose to publish it with all due acknowledgments in the *Journal of the Bombay Natural History Society* or the *Journal of Indian Botany* or both.

I should like to do this purely from the hobby point of view and I am looking for the personal element of corresponding and working direct with someone interested as I am in the subject, and not the sending of specimens officially to a museum which I find unsatisfactory.

Perhaps you may know of someone on your side of the world who might care to write to me about this. If so the address given will always find me.

The Agricultural College, RUDOLPH D. ANSTEAD.
Coimbatore.—Lawley Road P. O., South India.

Industrial Depression

To the Editor of the SCIENTIFIC AMERICAN:

Is there no cure for this, and what is the actual cause? We were all advised to work and save to remedy the effects of the waste of war. Everybody, nearly, has done so (if cutting off luxuries, wearing old clothes, and generally doing without is saving). There are also bread lines in cities and men strong and willing, unable to get work. It is an axiom that "wealth and money" are "labor or results of work." Then here is "wealth or money" being wasted and refused. The demand is always there, the material is there, and the labor is there. What is missing? It must be the go-between capital or money. In other words, a piece of paper or pieces of metal. Surely, human brains can find a remedy for this. During the recent war the human race made an immense effort, perhaps the greatest it ever made—and the purpose—the destruction and injury of their fellow men and destruction of valuable material and property. If an effort for that unspeakable purpose can be made and paid for, surely there must be the means to pay in an effort to supply the demands of the human race. There is certainly something seriously wrong with the arrangements. Is it not the medium of exchange? We are unable to barter or exchange our work or goods for others that we want. Cannot some of your readers suggest a remedy? Is the whole banking system wrong and the gold standard, or are we to await another war to make things better?

Kamloops, B. C. ARTHUR SHERMAN.

Amos W. Hart: Edward W. Byrn

BY a curious coincidence, there died in Washington, D.C., on September 21st, two of the members of the Washington patent bar of longest standing, and both of long connection with the firm of Munn and Co. Mr. Amos W. Hart was in his eighty-first year, and until the illness which resulted in his death he had for 54 years been on the regular staff of Munn and Co. Of course he was in this office longer than any one else ever attached to it, and we venture the assertion that few business connections stand the strain of years as well as did his. The members of the Washington office of Munn and Co. are flattered by the idea that Mr. Hart was in many respects a remarkable man. He had unusual information, rare intelligence, great industry, and extraordinary conscientiousness. He was one of the finest of the many representatives of that class of highly capable professional men who prefer to settle into the orderly discharge of the duties of a responsible position, rather than assume the less agreeable task of carving out an independent career. It is men like Mr. Hart who go farthest toward refuting the impression that one sometimes gets, that a professional man who is content to work on a salary must necessarily be of less than the foremost caliber. His authorship of "Hart's Digest of Patent Decisions" would alone establish his professional standing, if his long and honorable career in the office of Munn and Co. were not cited at all.

Side by side with Mr. Hart there sat, for many years, Mr. Edward W. Byrn, ten years Mr. Hart's junior. Though not with Munn and Co. at the time of his passing away on the same day as Mr. Hart, Mr. Byrn had spent practically his whole business life with them, prior to his retirement from active practice several years ago. He was a man of the same type as Mr. Hart. In its personnel and in its recollections the office of Munn and Co. is the poorer by virtue of their taking off, and the patent bar of our capital city is a loser only in less measure.

Making Lenses In America

How the Electrically Heated Melting Pot Is Putting Us on a Par with Germany

THERE was a time when almost every telescopic peek at the heavens, practically every binocular sighting of a distant object on land or sea, even that interesting glimpse, a close-up of the stage through opera glasses, was a tribute to Germany. But not today.

There was a time when the whole world looked to the troublous nation for most of its fine lenses, for the bulk of its optical glass of every sort. In this country when we thought of lenses we instinctively thought of that highly scientific city, Jena, where dwelt and toiled a painstaking and thoroughly schooled guild of glass workers. German trade propagandists saw to it that we did.

But we don't today. A new American industry with electricity's aid sees to it that we don't.

That new industry's real reason for being lies in the fact that when the United States went to war in 1917, the army and navy had to recruit binoculars, hand telescopes, even pearl mounted opera glasses from the homes of America so that the fighters might see. There was no other source sufficiently prolific. The supply from the usual sources was cut off.

The supply never will be cut off again. There is an American optical glass industry which is capable of producing every type from tiniest discs to great lenses large enough and accurate enough for the most powerful telescopes in the world—thanks to electricity. Right now it is turning out 40-inch lens disks whose quality is not exceeded by the output of Jena or any other glass-producing point.

A 40-inch lens! Made in America! A few years ago such a thing would have been hooted. Nobody in this country attempted the making of such a lens. Why try it? Let the German make it.

Nobody here could do it principally because, even if a sufficiently large potful of sand and potash and litharge and the other elements were melted and stirred at the right temperature—say 2,200 degrees Fahrenheit—nobody knew how to cool it down in a dependable, scientific manner.

Cooling of glass is a science. To cool a huge block such as that from which a 40-inch lens is ground requires weeks and there must be an accurate steadiness of heat such as is little known in most industries. If the block cooled faster than a few degrees an hour, if it cooled more quickly in one part than in another, or if the rate of heat decrease varied much from a required schedule, then stress lines would inevitably appear. These strains are ruinous to the accuracy of even the most artfully ground lens, for grinding and polishing affects only the surface. Also the strain might cause the block to crack at any stage of its production, thus wasting much expensive effort and material.

Formerly, the glass-annealing furnaces of this country were all fuel-fired. They had their limitations because their temperatures could not always be controlled accurately enough for the making of finest lenses even in the small sizes. They were helpless before the task of producing the large ones demanded by modern astronomy.

Then came electricity. First the batch of glass is melted, pressed into soft blocks and then put into electric lehrs for annealing and proper cooling. Once it was a good lehr, fuel-fired, which maintained a heat that varied not more than 10 degrees Centigrade from normal. The electric holds this variation down to less than 3 degrees. In the cooling, after the glass is annealed, the heat decrease is accomplished with amazing steadiness. In one set of exhaustive tests, the variations from the desired mean temperature were less than one per cent.

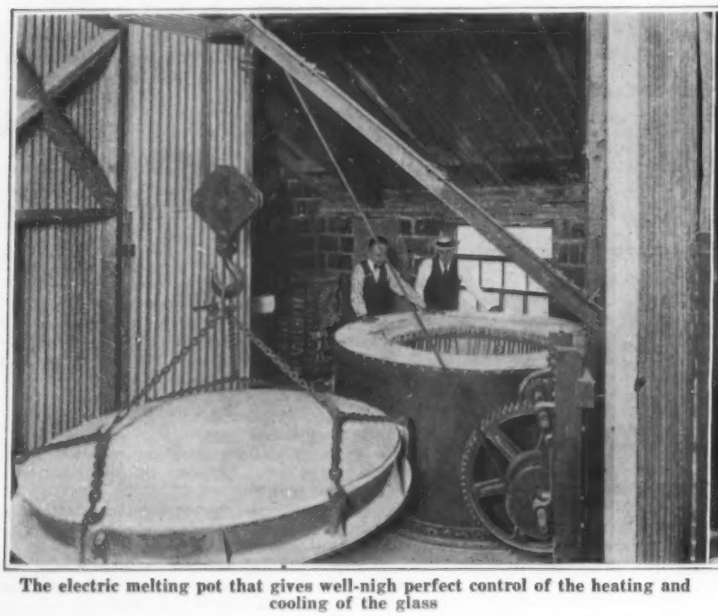
This control is automatic. A set of thermo-couples, acting as thermometers, is put into various parts of the furnace, constantly measuring the heat and recording it outside. These thermo-couples are connected to heat-controlling apparatus which changes the feed of current so as to hold that heat uniform.

Where exact temperature cycles are needed for a series of anneals on glass products, they can be reproduced any number of times with hairline accuracy by operating the control instrument with a time-keeping motor supplemented by a simple cam set to produce predetermined rates of heating and cooling.

This sort of equipment made possible the manufacture last spring of the country's first perfect 22-inch disc and, more recently of the 40-inch piece in the same factory. These glass blocks come from the annealing processes—which take twelve days in the case of the 22-inch disc and twenty-eight days for the larger one—ready for the grinding, first with coarse abrasives and then with fine, and finally for polishing with rouge under a felt tool.

These polished slabs undergo a critical inspection which is the test that approves or condemns the methods used in the furnaces. It is in this inspection that use is found for instruments such as the polariscope to determine whether annealing is perfect and the spectrometer to measure the refractive index of the slab under examination.

If the glass fails to meet the tests, the loss is considerable, for good optical glass is no common product. The even heat of the electric furnace throughout its interior due to electricity's peculiar quality of uniform radiation and the furnace's perfect insulation, its exact control, and its freedom from all gases that might contaminate the furnace charge, are proving to be the factors enabling America to meet Germany and its vaunted Jena on an even competitive basis.



The electric melting pot that gives well-nigh perfect control of the heating and cooling of the glass

Inspecting the finished product with the polariscope and other instruments seldom met outside the laboratory

Turbo-Generator Operated Five Years with Only a Few Short Stops

FOR five years a 3200 kv-a turbo-generator has been operating in the power plant of the City of Saskatoon, province of Saskatchewan, Canada, without a breakdown to mar the continuity of its performance. This, while not a record, indicates a sturdy mechanism that carried its load despite the severe handicap of extremes in temperature, which are common in that portion of Canada in which the generator is located, and which might well be taken as sufficient justification for any irregularity of operation that such a machine might show.

The unit was installed by the Westinghouse Company in 1914, being put into operation November 24 of the same year. Except for a short period in the summer of 1919, it has been continuously available for service. Furthermore the unit was not taken off the load at that time on account of mishap to the electrical units of the machine proper.

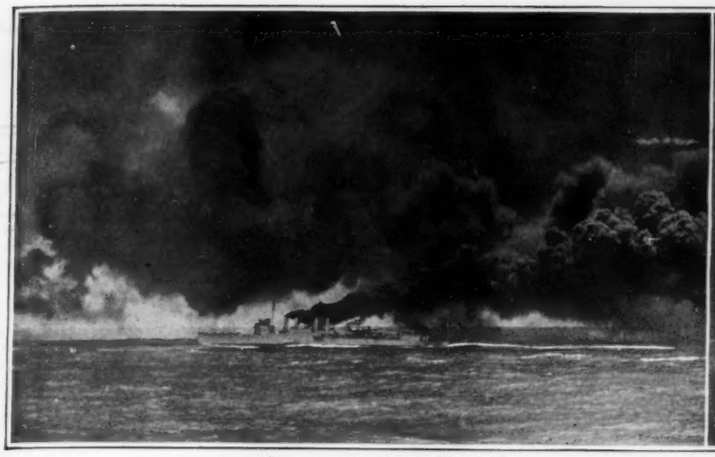
According to the chief engineer of the City of Saskatoon, the periods when the unit was not in operation are not on account of non-availability for service, but on account of the load being so light at the time that it could be carried by a smaller turbine.

Other performances are stated by city engineers. In summary, they show that the governor operated between extremes of load which varied from 300 to 2850 kw. in perfect control. The only portion of the entire equipment that was ever removed was the governor pedestal cap for the purpose of renewing a gasket on the bland runner joint. The condenser, too, has proved reliable. On one occasion when ice shut off the water intake 17 times in an eight-hour run no trouble to the tubes or plates occurred under this unusual strain. The La Blanc air pump never has given any trouble with condensing water at a proper temperature, having shown that it was quite easy to run as low as point six from the barometer, at all loads. In conclusion the chief engineer stated that any records of economies of this unit exceeded those guaranteed by the Westinghouse Company.

In regard to the graph also prepared by the city officials, two runs of long duration can be noted. The first of these is from October 6, 1916, to April 22, 1917, and the second from June 12, 1917, to March, 1918. In the first run the load factor was 46.3 per cent while in the second it was 46.6 per cent.

An inspection of the unit was made in August, 1920, at which time no replacements were necessary, as no wear was noticeable.

Since that time, the chief engineer states that the unit has been operating satisfactorily and shows indications of an unusually long life.



A smoke screen in the making

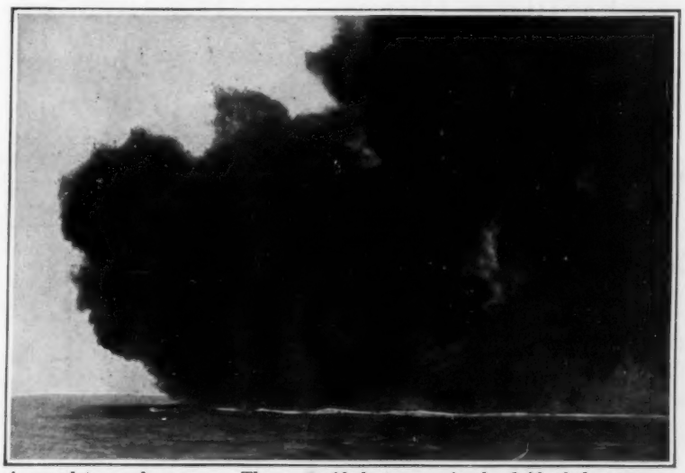
From the inside of a smoke screen, looking out

How a Sham Battle Is Fought Today

IMAGINE thirty-eight real torpedoes rushing suddenly at your ship and not an enemy vessel in sight!

That sight was the climax of the spring battle maneuvers of the United States Pacific Fleet which were carried on for several months. During the exercises there was hardly a day during which some new battle tactics were not tried out, but the most dramatic was saved for the last, when a sham battle which included aircraft, destroyers and battleships, took place some fifty miles off the port of Los Angeles, where the fleet is based.

With the location of each branch of the fleet unknown to the others, the seaplanes which acted as the battleship divisions' scouts quickly sighted the approaching enemy—nineteen destroyers. Simultaneously the blimp "B-3," the destroyers' reconnoitering force, sighted the oncoming battleships.



A complete smoke screen. There are 19 destroyers in the field of the camera. Can you find one of them? The enemy gunners cannot

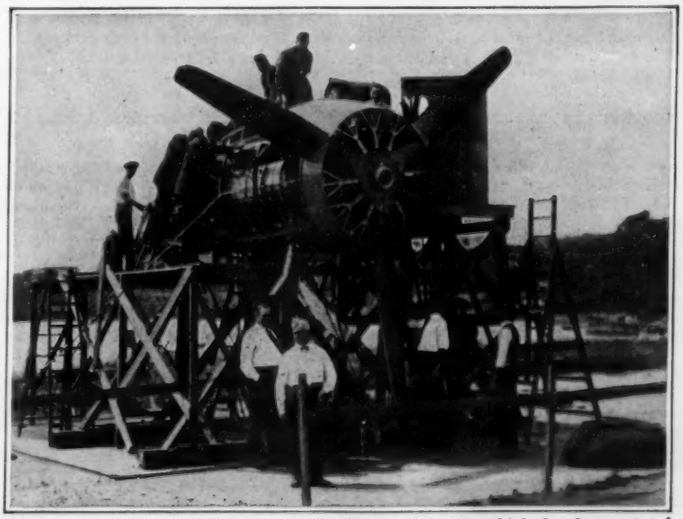
Immediately a smoke screen was laid in which the swift little destroyers could move about unobserved by the battleships. Probably a more effective smoke screen never was laid. With atmospheric conditions perfect, the screen completely covered all nineteen of the destroyers, making them impossible to locate.

Observers on the battleships suddenly saw a splash near the edge of the smoke screen; then a flashing white line in the intervening water; followed by a dull thud. The torpedo had found its mark and hit squarely on the bow of a "battleship." The torpedoes, of course, carried dummy war-heads in place of the war-head proper, which carries several hundred pounds of T.N.T. So the battle continued with thirty-eight of the torpedoes emerging from the smoke screen. Several of them found their mark. The battleships managed to avoid many, however, by sharply turning when a torpedo was sighted, so that it passed by. At the end of the fight, it was learned that all four of the big superdreadnoughts had been technically sunk.

This brief account, coupled with the accompanying photographs, will give a brief idea of the literal way in which torpedo battle maneuvers are being accomplished by the United States Navy. There was a time, not long removed, when sham battles were more or less theoretical affairs, in which maneuvers were conducted by text-book methods. Not so with the modern navy. Today Uncle Sam takes out his big and little fighting craft, provides them with all the apparatus of actual warfare, save the actual disasters, and has them "shoot it out."

It is not necessary to emphasize here the difference in the resultant effect upon the real backbone of the fleet—the common sailor. Formerly he was merely the subject of a lot of orders and, at the end of several weeks, learned that his ship had won the sham battle. Now he goes out; he sees actual torpedoes coming through the water at his ship; he sees aircraft flying above him dropping bombs upon it; he sees his ship firing actual shells at targets; he sees the battleship turn and twist to avoid the enemy. In short he *sees* the results instead of reading a technical report of the effect that might have resulted had all observations and calculations been correct. The result is an interest and a morale of the kind that wins battles.

The latest manoeuvers have been of inestimable importance in many ways. It may reasonably be expected that the practice of simulating actual naval engagements in all their details will become universal in all naval manoeuvers of the future.



Triple-engined Gallaudet power unit for huge airplanes, which develops a total of 1200 horsepower

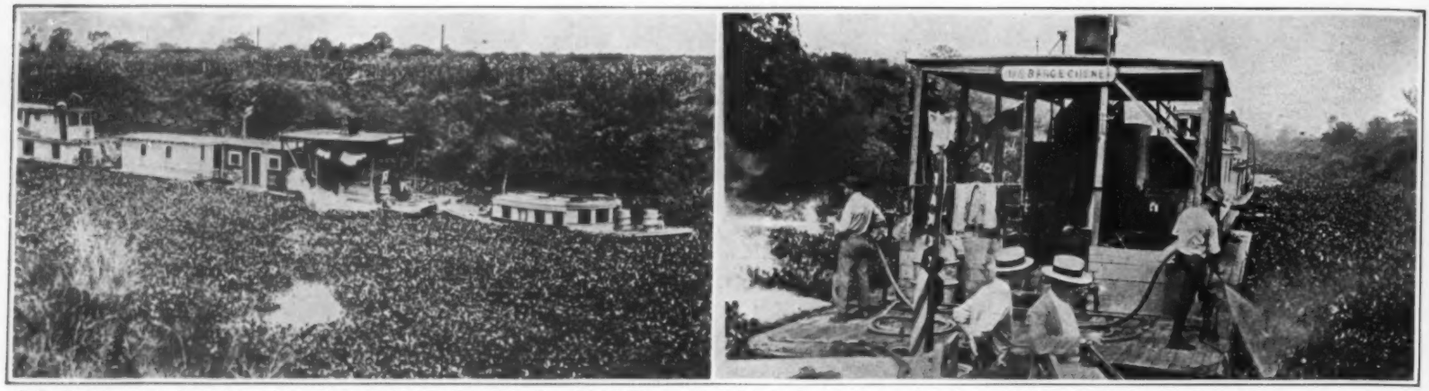
Semi-Diesel Engines

MANUFACTURERS of semi-Diesel engines do not intend to leave the field of large motor-ship construction clear for Diesel engine builders, and sets of the former type of 500 h.p. per engine are now being standardized by two or three firms, states the *Times Engineering Supplement*. Very few installations of such power have, however, been made in Europe, although there were many examples in the United States during the war, and the construction of a 2,700 tons ship in Holland equipped with two 500 b.h.p. semi-Diesel engines is therefore a step of some significance. The engines in this case are of the Bolinder type, and the designers have made a radical departure in at least one important direction. Usually with semi-Diesel engines of this size it is necessary for the bulbs to be heated for at least half an hour before they are started up. This may be regarded as one of the drawbacks of the semi-Diesel design, and in order to overcome it the manufacturers have now devised a means of starting from cold. Electric plugs of special design are fitted in the tops of the cylinder, and these are heated by the passage of current from accumulators charged from the electrical auxiliary plant. Even these large motors, it is claimed, can be started up almost immediately, and another advantage is the elimination of the blow lamps, which are somewhat inconvenient and always a possible source of danger. Many manufacturers of semi-Diesel machinery are adopting electric starting devices.

Three Engines in One

REALIZING that the future of the passenger-carrying airplane depends very largely upon the development of reliable and still more powerful engines, Edson F. Gallaudet, an aeronautical designer and builder of Warwick, R. I., has constructed a power unit for large aeroplanes which consists of three Liberty engines geared to a common propeller by means of a clutch mechanism. The power unit is shown on a test stand in the accompanying illustration, and its size, as well as the size of the huge three-bladed propeller, may be gathered from a comparison with the men standing about it.

The huge power unit, according to its designer and builder, is of sufficient size and power to assure non-stop flights from New York to Liverpool, in 20 hours or less. Two Liberty engines are placed side by side, and a third is placed at the rear. The plan is to operate two engines at all times with one in reserve. Each Liberty engine of the group develops 400 horsepower. The propeller is 18 feet in diameter. This power unit, as well as two others of the same type, is to be delivered to the U. S. Navy.



Left: Spraying water hyacinths with live steam, which kills them instantly. *Right:* The way it used to be done—with a costly and unsatisfactory arsenical spray, which failed to take account of the fact that cattle insist upon eating the poisoned leaves

Solving Louisiana's water-hyacinth problem. This menace for a time threatened to put most of her bayous permanently out of the class of navigable streams

Fighting the Water Hyacinth

Clearing the Clogged Waterways of Louisiana and Florida by Means of Live Steam

By Thomas Ewing Dabney

AT last a means of fighting the water hyacinth has been found, a means as cheap as it is efficacious; and the search of government engineers of more than 20 years has been ended.

The waterways of Louisiana and Florida that were in danger of being clogged entirely—many were practically closed to commerce during the summer months—are now safe for trade. In Panama and India, too, the menace has of late years been assuming equal proportions.

Live steam is the answer to the puzzle. Spraying live steam on the tangled, matted surface that broke the strongest steel cables, has been demonstrated a sure way of killing the pest.

The water hyacinth is a native of Venezuela, where it is known as "oreja de mula" (ear of a mule), or "buquelito" (little boat). Its botanical classification is "piaropus crassipes," and it is related to our native pickerel-weed family. Petioles or leaf-stalks distended with air at the base cause the plant to float after the seed that have fallen to the bottom of streams, sprout and rise to the surface. Six weeks later, the plants send up blossoming stems which bear 35 to 45 flowers of exquisite beauty, and produce an average of 170,000 seed a year, which ripen in four to six weeks in warm weather, or hibernate in cold.

So far as can be learned, the water hyacinth was first introduced into the United States in 1884, during the Cotton Centennial Exposition held in New Orleans. It excited great admiration, and visitors carried away plants for their garden pools and ponds. In this warm semi-tropical climate, the water hyacinth throve amazingly, and quickly filled these limited areas. The surplus was thrown into the bayous and was carried by the action of the current throughout the state, where the water hyacinth found conditions peculiarly adapted to its growth. More and more it began to clog the streams. So rapid is the growth that a bayou 150 feet wide with only a fringe of water hyacinth on the edges in March will be completely covered, from bank to bank, with a tangled, matted mass in June—an almost solid subaqueous crust through which boats can not pass.

As a vast section of southern Louisiana is served by waterways, it is apparent what this means commercially. This beautiful pest has been a serious difficulty in the way of developing waterway service of recent years, since the government gave the cause such an impetus through the Mississippi-Warrior barge line.

Sawmill interests along Bayou Plaquemine began to fight the pest in the early nineties. They sent gangs of men up and down the bayou with pitchforks to clean out the bayou and keep the way for navigation open. But by 1896, it was apparent that more heroic measures were needed.

In 1897, an appeal was made to the federal government; and in 1899, the first federal appropriation was made. It was for $25,000.

A steamboat was purchased and fitted at the forward end with a conveyor four feet wide, which scooped up the water hyacinth and passed the plants back through a series of rollers where they were mangled and discharged upon the bank.

This method was slow and expensive, costing about six cents a square yard. Furthermore, the hyacinth grew faster than the rollers destroyed.

Various acid sprays were then used—nitric, sulphuric, hydrochloric, etc., but they had to be made so strong that the cost was prohibitive.

Crude oil was spread upon the waters and set afire. It burned the tops of the plants very effectively, but a new growth sprung up in a week or so.

In 1902, a patented poison spray costing three cents a gallon, or enough to kill 12 yards of water hyacinth, was used with considerable success. Then in 1905, the U. S. Department of Agriculture developed a solution of white arsenic and sal soda, which was used with such signal success in killing the Canada thistle that it was tried on the hyacinth. It cost less than half a cent a gallon to make.

This has been the method followed ever since. Boats equipped with spraying tanks, pumps, and hose would be sent into a hyacinth-infested waterway, and would slowly work their way through. Counting labor, it cost about one and three-fourths cents a gallon to apply the spray. The plants would wilt and die within three or four days.

If, however, there was a rain, the arsenic solution would be washed off and the work would have to be done over. Furthermore, cattle are very fond of the water hyacinth, and many died from eating the poisoned leaves. Cattle owners had to be warned in advance of the boat's coming, to pen their livestock. By many it was believed that the fish were poisoned, but this belief seems unfounded.

This spray did all that could be expected of it—but the government engineers confessed that it could not keep up with the growth of the menace.

In Florida, similar conditions have prevailed. In the Panama Canal, the government engineers have been fighting the inroads of water hyacinth for many years with arsenical spray. So choked had the waterways of India become in 1918 that the Indian government sent an expert to this state to study the arsenical method. In its native habitat, Venezuela, however, there seems to be a natural foe that keeps the water hyacinth from becoming a pest.

John Klorer, city engineer of New Orleans, who for five years had charge of the water hyacinth eradication work of Louisiana, came to the conclusion that the floral pest would eventually choke all but a few of the largest streams of Louisiana. "On account of the immense area infested," he said in 1908 before the Louisiana Engineering Society, "it is impossible to exterminate each and every plant by mechanical means or the poisoning methods now in vogue. We must look to plant pathology for a complete riddance. The investigating botanist may possibly find some natural enemy to the plant, some parasitic fungus, that could be cultivated and spread among the hyacinths and which would not be a menace to our agricultural interests."

Then came the solution—strangely enough through the suggestion of a layman—Governor Parker of Louisiana.

Since July, 1921, oil boats of the Texas Oil Company had been caught in a hyacinth-jam of Bayou Lafourche, an important waterway through the sugar section. One of the company's big boats, the S. S. "Hyacinth," towing a barge equipped with poison-spray apparatus, was sent to the rescue. Steel cable after steel cable was broken as the "Hyacinth" sought to force its way through the matted mass of roots and leaves.

G. Donnaud Bentley, of the Texas Oil Company, was discussing the problem some time later with Governor Parker at Baton Rouge.

"Why not shoot live steam on the water hyacinth?" suggested the governor.

It had never been thought of. The idea was given a try-out. It worked. The first application was made in August. The tops of the lilies immediately wilted. Hotter steam was thrown on. The effect was magical. And the boat, shooting broadsides of live steam, forced its way through the growth at the rate of a mile and a half an hour. At one place, a solid mat of hyacinths, nine miles long, was encountered.

This was done with improvised steam-throwers. Now plans are being made to set the steam nozzles flush with the water, so that the roots, bulbs and all will be destroyed.

That is the situation today. Sufficient work has not yet been done to determine the average cost of operation, but it is obvious that the steam method is considerably cheaper than the spray method. It is more rapid, and rains and heavy dew don't hold it up, thereby giving the water hyacinth another handicap in its remarkably rapid growth. There is no wake of poison to menace the livestock of the region.

SOME years ago New Orleans had an exposition, in connection with which a few water hyacinths were imported and shown. After the show was over, there were requests for these handsome plants for gardens; and they were distributed in this way. The result was somewhat similar to what happened when Australia introduced the rabbit. For some years an outstanding problem has been the freeing of Louisiana's waterways from the mass of hyacinths, which makes navigation utterly out of the question. Mechanical means are outlawed by the rapid rate of growth of the plants. Poison is out of the question, as has been found to the cattleman's cost. Now live steam has been suggested, and tried out on a scale which makes it seem certain that the answer has been found. This is the story that Mr. Dabney tells us here.—THE EDITOR.

A Model in Appearance and Production Alike

SO skilled are the average model makers of today that they can duplicate virtually any piece of machinery, ship, factory or whatnot on a miniature scale. They work with plaster, small castings of brass and lead, carefully and ingeniously applied paint, and so on; but the very nature of these materials renders the usual model a rigid, lifeless proposition. It is one thing to secure realistic effects, and quite another to secure such effects and actual operation, as well.

This model paper-making machine turns out paper from wood pulp, duplicating the operation of a full-sized machine

A happy combination of realistic appearance and actual operation is represented in the little paper-making machine which was recently shown at a graphic arts exposition in Chicago. This machine, which is depicted in the accompanying view, is a real paper-making machine in every sense of the word. The average paper-making machine is more than 200 feet long and weighs several thousand tons. The model paper-making machine is less than nine feet long. Some of its bearings are as fine as those of a watch. This machine carries out every operation for the making of paper, from the time the pulp is fed to the grinder and through every process to the finished paper, which is rolled up at the left of the illustration. The paper comes out in continuous strips four inches wide.

A Two-Car Garage with a One-Car Doorway

AN angular garage of the type shown in the accompanying illustration has many advantages. First of all, it takes care of two cars—one in each wing; yet the doorway is only wide enough for one car at a time, hence considerable space and expense is spared in such a building. Each car can enter or leave the garage without disturbing the other car, always providing, of course, that both cars do not attempt to enter or leave at the same time.

The angular garage: A two-car garage with a one-car doorway

World's Largest Tent Hangar

ENVELOPING an area of 130 by 30 feet in dimensions, a tent hangar recently erected by the United States Air Service at McCook flying field, Dayton, Ohio, has been awarded claim to supremacy as being the largest in the world. With a clear opening across the front, this tent hangar is sufficiently large to accommodate three Martin bombing machines. Its value to aircraft service is contingent upon its ability to withstand the weathering test satisfactorily.

This tent hangar, erected at McCook Field, is said to be the world's largest

Turning Live Steam Into Weed Destroyer

AN invention which has proven to be one of the greatest labor saving devices for railroads in recent years is the weed destroyer recently patented by Harry M. Williams, veteran locomotive engineer of the Missouri Pacific Railroad, and the late J. W. Dean, general superintendent of that line.

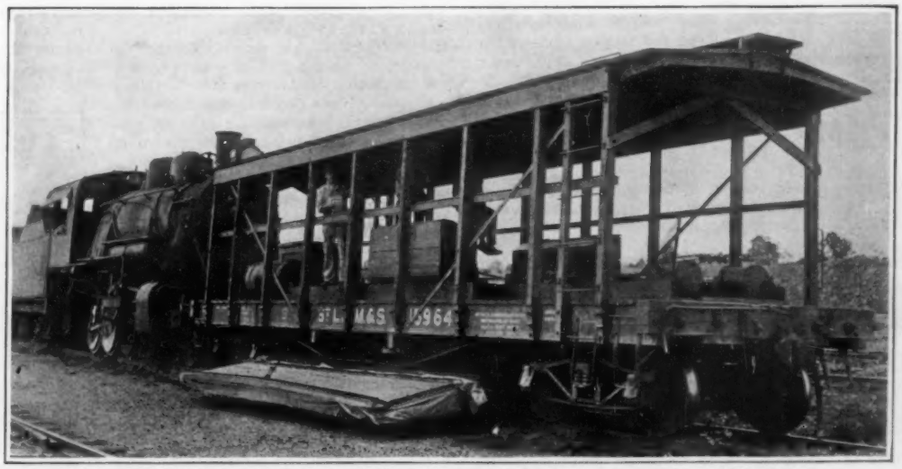
The machine consists of a system of pipes installed on a forty-foot flat car and used in connection with either a saturated or superheated locomotive. Superheated steam from the locomotive is applied direct to the vegetation, snow or ice, at a temperature ranging from 550 to 650 degrees, Fahrenheit.

The main burner of the apparatus is installed under the center of a flat car, with burners or wings extending out from each side of the car to any distance desired. Curtains of asbestos cover the wings and confine the steam to the surface being treated, thereby insuring a maximum degree of heat. The wings are raised or lowered by means of air hoists, thus avoiding striking switch stands and other obstacles along the track.

In connecting the burner to a superheated engine, the communication between the boiler and cylinders is shut off with a gage valve and steam pipe. Two auxiliary valves are arranged, one to operate the locomotive and the other to furnish steam for the destroyer. All work is performed with the equipment backing for the reason that the extreme heat and the facilitating the immediate piping connections from the superheated unit to the burner car which saves heat units.

Three pipe lines are extended from the locomotive, one 2½-inch pipe extending to the main burner and one 1½-inch pipe to each of the two wings. A network of three-quarter inch pipes is fitted on the wings, in which there are ⅛-inch holes about six inches apart, drilled staggered, through which the jets of steam are forced.

These machines have proven economical of operation, cleaning the track of vegetation at a cost ranging from $8 to $12 per mile. From twenty to twenty-five miles of track may be treated a day with the destroyer. It is also used by several of the railroads to melt snow and ice from around switch stands and frogs in larger terminals in winter.



A weed destroyer for railroads, which makes use of the destructive action of live steam

Do Moths Use "Wireless"?

BY what means is the male moth acquainted with the fact that the female is asking for his attentions? Certainly it is not by scent, for the males travel *down the wind* to the place where the female is just as surely as they will fly into the breeze. Another suggestion is that the males are attracted by sound which is inaudible to human ears. That there is nothing in this suggestion has been entirely disproved for the female Vapourer has been enclosed in a soundproof box and still the males come to her with unerring instinct.

It has lately been suggested that these insects communicate with one another by means of "wireless." It is said that they do this by means of electromagnetic waves of exceedingly short wave length. Well established facts seem to lend color to the suggestion. Probably the most sensitive organs that moths possess are their antennæ. The antennæ of the female, who is the transmitter, differs in pattern from those of the male who is the receiver. This fact agrees with the design of wireless instruments. Another curious point is the behavior of the male as he nears the place where the female is stationed. Often he will alight in a very uncertain manner moving his antennæ about much in the same way that a wireless operator will swing his direction-finding frame in order to discover the quarter from which the signals are coming.—By *S. Leonard Bastin.*

Inventions New and Interesting

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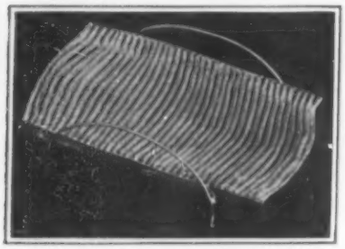


This dish of gauze is of great aid to the chemist

A Novel Laboratory Vessel

THE curious illustration that accompanies this text represents a dish of great value to the chemist in the determination of solid matter of any fluid. It consists of a fine mesh wire gauze resting by means of supports in a dish and corrugated in such a way that it presents two surfaces of approximately 200 square centimeters each. Due to the close proximity of the grooves these can exert a strong capillary action, so that the gauze will hold at least 5 cubic centimeters of any liquid without any of it going through the meshes.

Due to this large surface and to the effect of the meshes and corrugations in maintaining a wide and even distribution of the liquid, dehydration is entirely uniform and is carried on by the action of the atmosphere on both surfaces of the gauze; any one part of the liquid being subjected to the same drying condition as any other.

When a dish alone is used with an area usually of about 20 square centimeters the solids when secured are distributed irregularly over the bottom and uneven heating results, attended by charring in the case of saccharine and other organic liquids. If the liquid is distributed over sand, asbestos or pumice stone in a dish or cylinder, that which reaches the lower layers is subjected to different heating conditions than the rest; also unavoidably more of the liquid will be gathered in some places than in others. Even with stirring errors due to ineffective and uneven distribution cannot be entirely avoided. All these substances require thorough preliminary treatment before they can be used, and even then are somewhat limited in their application by the chemical nature of the liquid to be distributed over them. With the gauze-dish, the troublesome preparations and precautions required by these materials are entirely avoided, and the liquid comes into contact only with a material of a well-tested unreactive character. In addition to these drawbacks the absorption of hygroscopic moisture from the air during weighing is considerable when sand, etc., is used. This may be a source of error, even with the most painstaking precautions. With the gauze-dish, the absorption of moisture is comparatively slight.

This light will work wherever there is current

Trucks of Long Life

SOMEONE guessed, once upon a time, before we really knew what trucks would do, that the life of a motor truck was about five years, and in arguments both for and against the power wagon this life period is always coming to the front. Along the line of longevity, it is significant to note that entire fleets of motor trucks bought more than five years ago are still in operation and delivering the same efficient service as that required of new machines. A sight-seeing bus company of Chicago and New Orleans has five very early models still running continuously. They are all motor buses. One is 19 years old, another 18 years, another 17 years old, and the remaining two are 14 years old. Another New Orleans Company interested in a similar enterprise is still running five old buses regularly ranging in age from 8 to 13 years. A soap maker of Brooklyn has a fleet of eight old trucks between the ages of 8 and 13 years. A contractor of New York operates thirty trucks of 5-ton capacity each. The majority are over 9 years old while many have been in service for 11 years. A hauling contractor in Paterson, New Jersey, recently sold a 5-ton machine that he had run for 10 years without a single overhaul. A large department store of New York has 15 old models in its fleet of 62. They are from 8 to 12 years old. A New York fleet operator reports that his 10 old machines between 8 and 10 years old are still giving service as good as could be expected of new trucks. A New York sugar refinery operates a fleet of 15 trucks, all of which are over 8 years old.

Photographer's Portable Lighting Apparatus

THIS equipment is put up in very compact form in a specially constructed suitcase style of carrier. Set up on a rod, with tripod base, it can be opened and put to use wherever it is possible to get electric light connection. The muslin screen is for the purpose of obtaining a soft effect when the apparatus is used in portrait photography.

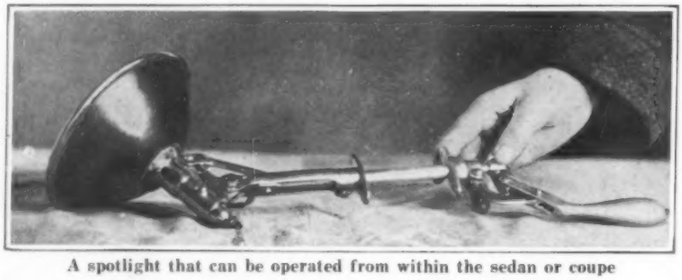
Wholesale Testing of the Life of Light Bulbs

UNCLE SAM has rigid requirements as to the quality of his office equipment that may ultimately figure in making the wheels of Government go round, and even the electric-light bulb is no exception to the rule. Life tests are administered by the National Bureau of Standards and if the lamps fall under prescribed specifications they are very promptly discarded.

Specimen lamps are selected by Government inspectors. They are burned on the racks to determine their life in hours to 80 per cent of the initial candlepower or to burn out if above 80 per cent candlepower. From these experiments is determined the acceptability of lamps supplied under contract to various departments of the Government.

An Adjustable Spotlight for the Closed Car

THIS spotlight may be operated from the driver's seat within a closed car. The long supporting rod is in two pieces, which may be taken apart for installation purposes. It passes through the slightly open windshield. The lamp is turned by means of the handle connecting with a shaft running through the supporting rod.



A spotlight that can be operated from within the sedan or coupe

This device can be used as equipment on any car and can very quickly be put in place. Its advantages, especially in winter, are obvious.

A Pneumatic Grease Dispenser for the Garage

THROUGH the medium of compressed air, taken from the ordinary receiver maintained at all first-class garages and automobile service stations for the inflation of tires, this device may be effectively operated for the dispensing of plastic or semi-liquid oils or greases, taking them directly from their original containers if so desired, and delivering them to transmission-gear casings, differential-gear housings, and the like.

In addition to providing a simple method of handling of lubricants this apparatus also combines the elements of speed, cleanliness, freedom from waste, and automatically and accurately measures all materials used.

The mechanism is simple and virtually fool proof. It consists of two ordinary cylinders with pistons, one for dispensing the lubricants and the other for pulling the main piston rearward, and recharging the main cylinder with lubricant. The entire operation, both dispensing and recharging, is controlled by a simple quarter-turn of a single three-way valve.

The lubricants can be dispensed from a nozzle of convenient size and shape at the end of a flexible hose of any desired length.

A device that uses the compressed-air supply to deliver grease to gear housings

The measuring device is adjustable in accordance with the grade of lubricant being used, and consists of an entirely visible scale on the surface on the rear cylinder. Combined with this is an audible signal composed of a bell which can be set to ring automatically after any given quantity of the lubricant has been dispensed.

The apparatus is very compact, and may be installed as a stationary or portable one.

Studying Glider Flights with the Motion-Picture Camera

THE extensive glider flights recently made in Germany have been followed with no little interest by the leading German aircraft designers and constructors, as well as by Fokker, the famous Dutch aircraft constructor, whose name became so well known during the war. In the accompanying view we have Fokker studying the glider flights by means of a motion picture camera. It will be noted that Fokker is using an odd camera support which comprises a small platform for holding the camera, and a pair of hooks that fit about the shoulders. Obviously, such an arrangement permits of much greater freedom in filming airplanes, gliders and other rapidly moving objects, than does the usual tripod. We note by the photograph that Fokker is using a Debrie camera, which is of French manufacture and weighs about 15 pounds.

Fokker, the well-known Dutch aircraft constructor, following glider flights with motion picture camera

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Uncle Sam's Big Camera

(Continued from page 253)

cially-designed rod which grips the edge of the paper without injuring it. The construction of this plate-holder makes it possible to copy directly from tracings and whatnot and renders easy the making of positives and transparencies—those beautiful pictures on glass for which the Geological Survey is famed.

A curtain made of nearly transparent material wound on a spring roller at the back of the frame is employed to get the desired lights and shades. Another unique feature of the copy-holder is the centering device. This consists of four cords, two of which cross the plate vertically and two horizontally. They are manipulated by a slide at the top of the holder which, moved toward either end of the frame, gives the exact margins for the sheet to be photographed. A slide-rule, perfected for this machine, determines at once the size of plate to be prepared for exposure without the usual measurement on ground glass.

Focusing is a simple process with this giant among cameras. There are two scales, one on either carriage, on which the degree of reproduction is indicated, and the two carriages are moved until the figures read alike on both scales. That is the thing in a nutshell, but in detail it is worked out like this: An electric contact is set at the desired point on the scale of the copy-holder carriage which, with another contact, is then put in motion. When the two points meet and the circuit is completed, a small incandescent lamp flashes the signal to stop, that the copy-holder is in exact position. Should it happen that the carriage runs past the point of contact, the operator uses a fine-adjustment hand-wheel to bring it back, when the little lamp will again send out its glow. The photographer then turns his attention to the primary carriage with the lens and prism. He sets the scale, corresponding to that on the other bar, and starts the motor which drives the carriage along until the proper figure is reached, again using a hand-wheel for accurate adjustment. It is all so easy that the picture-maker can be up and away to another job while his friend with the ordinary copying camera is fussing and fuming over bothersome details.

Reversible motors drive the two carriages with astonishing ease and precision. As has been stated, the copy-holder is always in correct alignment with the lens and plate-holder, so that the camera front never budges a hair's breadth unless the copy-holder moves in the same direction, but both can at once be driven forward or backward as occasion demands.

Cooke lenses of 31 and 42 inches focal length are used in combination with a Cooke prism. These, attached to a heavy brass plate, will make a picture large or small. As accuracy is the paramounnt consideration, the optical parts must be in just the right position and absolutely rigid. Plate and copy-holder are plumb or, if not, can be made so by screw movements on each part, while the prism is brought into alignment by a thumb-screw passing through a strong brass bracket which runs out beneath it from the front-board.

And this completes the description of the biggest of all metal cameras—a thing of mechanical perfection which has earned Uncle Sam a place in the sun. While you are meditating over its astounding performances a servant of the people is preparing for another picture. He frets not with the cumbersome stand of the older machines but moves quickly and freely around all the parts. The result may be a classy map of the known oil fields or a chart of mineral production, or perhaps a map of the United States from which some little tot in a small town will get his first lesson in Americanism.

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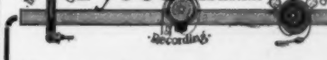

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